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USSR Report

SCIENCE AND TECHNOLOGY POLICY

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ORGANIZATION, PLANNING AND COORDINATION

TACTICS, STRATEGY IN CHOOSING RESEARCH THEMES

Moscow KHIMIYA I ZHIZN in Russian No 3, Mar 85 pp 22-28

[Article by Doctor of Chemical Sciences G. V. Lisichkin: "The Choice of Themes: Tactics and Strategy"]

[Text] It is customary to divide science into basic and applied science. It is believed that applied science is called upon to solve only the specific problems which practice poses for it. The main goal of basic science is to study the general laws, which are the basis for phenomena of nature, but not necessarily to give direct practical results.

The assertion that the search for practical results without preliminary basic research quickly turns into empiricism, which is almost guaranteed to be doomed to the pointless expenditure of time, efforts and assets, became a commonplace long ago. For example, it is possible to recall the lengthy, but unsuccessful attempts to obtain a synthetic diamond from graphite, which were made without a knowledge of the thermodynamic conditions under which this process is feasible. And although even in our times the share of empiricism is still very great in several very important areas of research (such as, for example, the search for new medicines), it is quite clear that the expenditures on the study of the properties of the "graphite--diamond" system or on the development of the theory of the effect of pharmaceutical preparations, which is still be formulated, is not a waste of money. It is really necessary to develop basic science, since natural progress is impossible without it.

With the increase of the educational level of people this idea turned into common property, and it became a prestige to be engaged in basic science. Moreover, the opinion that only the person who is engaged in basic (or, as they sometimes say, "pure") science is a genuine scientist, became widespread (and not only among scientists themselves). While all others--what are called "applied scientists"--constitute something in the nature of the lowest caste. The demand of "the man in the street" for immediate organizational conclusions, if as a result of many months of activity of an entire collective of scientific associates (a portion of them are high-paid) a brief note appears in a specialized scientific journal, which is published in an edition of 1,000 copies, is becoming an anachronism. The lovers of exact figures have

calculated that the cost (for the state, of course) of one line of such a publication amounts to several thousand rubles.

But, perhaps, "the man in the street" is right? For they say that no one reads more than 80 percent of all these incredibly expensive article.

Here the reader, perhaps, will suspect the author of intending to make another sap under the well-proportioned building of basic science. No, my goal is different: I want to attempt to list the means and to evaluate the methods, which make it possible to find the most important, promising sections of basic science, which are capable of sooner or later serving practice. The complexity of the problem consists in the unusual diversity of basic science. A chemist can study, for example, the dependence of the speed of one reaction or another (and it is even difficult to estimate the number of reactions) on hundreds of the most different factors and their practically infinite combinations.

It is clear that the problems of basic science, which are of no obvious practical importance, can differ greatly in theoretical importance. That is, along with operations, which lead to important theoretical generalizations, as well as are devoted to the search for special laws or are aimed at supplementing reference works (which is also very important), research, which leads nowhere, is inevitably performed. And this is even on the condition that it is a matter of skilled and conscientious scientists, who know how to arrange experiments competently and to interpret their results correctly, and not of charlatans and cheats, who parasitize the body of science.

In recent years the economically developed countries have entered an age of the limitation of financial investments in science, an age of the stabilization of the number of scientists. Now they recall with a smile the forecasts of futurologists of the early 1960's, according to which by the beginning of the 21st century the entire population of our planet will be taking part in scientific research.

These forecasts were based on the formal extrapolation of the increase of the number of scientists, which was observed at that time. The quite natural conclusion of the period of the extensive growth of the edifice of science, which is now being observed, is having the result that the advancement in position of associates of scientific research institutes and higher educational institutions is slowing drastically--candidates of sciences, who are approaching retirement age and continue to work as junior scientific associates, have already become quite ordinary. At the same time as a result of the freezing of the permanent staff of scientific and educational institutions the acceptance of new themes can occur only by the closing down of old directions and the transfer of people to new directions of research. This is a painful process: it is easy to understand the profound resentment of a person, to whom they announce that the theme of his many years of as if quite successful and at any rate conscientious research is unpromising.

Thus it is clear that under the conditions of limited financing the problem of choosing the most promising themes inevitably arises. How does this process occur at present?

First of all a word about those who choose scientific themes. As a rule, these are scientists, who have the qualification of not less than a doctor of science or (at higher educational institutions) the title of not less than professor; however, numerous instances, when candidates of sciences and even "non-degreed" associates determine the choice of themes, are also well known.

The scientific associates and instructors of higher educational institutions form without fail collectives which are united by work on a common scientific problem. So then, the leaders of these collectives usually also determine the choice of themes (I remind you that it is a question only of basic science). It is clear that not only a chair of a higher educational institution or a recognized laboratory of an academic scientific research institute, but also a junior scientific associate with his only laboratory assistant can be a scientific group.

By what is the leader of a group usually guided when choosing problems? In the ideal case a scientist is distinguished from a person of any other specialty by the fact that he has undying curiosity, which in official documents is called "scientific interest." And if this quality of the scientist is based on thorough training, if the leader of a group has gained adequate personal scientific experience, usually it is entirely possible to rely on his choice.

Unfortunately, when planning a new direction of research even the ideal leader cannot be guided only by his intellectual curiosity, but should also take into account a large number of additional (for the most part extrascientific) circumstances. Here are the basic ones of them:

1. The provision of the laboratory with skilled personnel, as well as the necessary instruments, equipment and reagents.

2. The possibility of obtaining in a reasonable time if only an intermediate or preliminary result (in case of the 5-year system of planning this is approximately 2-3 years).

3. The possibility of obtaining results which are of practical significance, which will make it possible to increase financing by means of economic contracts.

4. The competitive ability with respect to the domestic and foreign laboratories which deal with similar problems.

5. The notorious ability to be used for a dissertation, that is, the need for the creation of the conditions for the scientific and (what is of no little importance) job advancement of his associates (and he must not forget himself!).

It is clear that it is far from simple to combine painlessly all the listed conditions. But the main trouble is that very often the above-listed factors have a decisive influence on the final choice of a direction and lead to work on minor themes; if they are not taken into account at all, the result can prove to be most lamentable. In most cases basic science should be cultivated

wherever all the listed conditions are observed--at large scientific centers, scientific research institutes and higher educational institutions.

But what, let us say, is the head of the physical chemistry chair of the N oblast industrial institute (at which, suppose, there is a little modern equipment and which is fairly well financed) to do, if he cannot hire a young doctor of sciences and two graduates of the graduate studies of an academic institute only because of the lack of housing?

The shortage of skilled personnel is the most serious form of shortage. In this case, apparently, it should be honestly admitted that the chair does not have enough forces for basic research. This by no means implies that the collective should engage only in teaching--the chair simply needs to concentrate quite consciously on the solution of some special applied problem. And thank the head who will choose for his associates work within their power (and to their liking) and, moreover, work which is of truly great practical importance.

Experience, however, shows that often such collectives prefer to avoid the specific problems of practice and, having taken refuge in the flag of "pure" science, for decades engage in research, the results of which no one needs and obviously no one will ever need.

What has been said does not mean that the author groups applied research with "second-grade" scientific activity. Both in creative effort and especially in the brought moral satisfaction applied science is not inferior to basic science. It is often much more difficult and interesting to work on a specific applied problem than to make routine "fundamental" measurements. And there is no comparing the feelings, which emerge in case of the successful completion of the tests, say, of a new medicine which was developed with your participation, with the cold emotions of a "fundamentalist" who has obtained the 1,001st curve.

Nevertheless differences still exist between applied and basic science. Scientists, who have a specific practical mentality, primarily engage in the former, while specialists, in whom abstract thinking is highly developed, engage in the latter. Life shows that the latter type of scientists is encountered more rarely.

In our country several thousand scientific groups are engaged in chemical research. Some are working more or less successfully in the area of basic science, others--in the area of applied science. And many, unfortunately, are squandering their talents on trifles which no one needs, while truly important problems remain untouched virgin land. Do methods, which make it possible to control the choice of scientific themes, exist?

Steps on the regulation of scientific activity are being taken both centrally and locally by the organs which manage science. First of all one should mention the comprehensive goal programs of the USSR State Committee for Science and Technology and the USSR Academy of Sciences and the research programs which are formulated by individual ministries and departments. There

is no doubt: such programs are of great benefit, but they, as a rule, concern, though important, still applied problems.

A very simple step, which was taken by the USSR Higher Certification Commission, yielded a definite effect: in conformity with the statute on the defense of dissertations the abstract of each of them should contain sections, in which the novelty and the theoretical and practical importance of the work are formulated concretely. But these sections, of course, are compiled by the author of the work and therefore are far from always objective.

The USSR Ministry of Higher and Secondary Specialized Education recommends that categories be established for economic contractual operations subject to their importance; here the wage fund with respect to economic contracts of the lowest category is appreciably less than with respect to economic contracts of the highest category. But the establishment of a category is also to a sufficient degree a subjective act. Moreover, the overwhelming majority of economic contractual operations (just as comprehensive goal programs) are aimed at the solution of applied problems.

The reader, who is not directly involved with the work of scientific research institutes and higher educational institutions, may ask the puzzled question: Do the scientific councils really not formulate the themes of the institutes? And there are, of course, management personnel who are specially responsible for scientific work. Does not the choice of themes belong to their competence?

However, an experienced person knows that scientific councils are engaged 90 percent of the time in the examination of dissertations, while they spend the remaining 10 percent of the time on listening to reports, that is, on analyzing what has already been done. The role of administrators in the formulation of new basic themes is even smaller. The reason for this lies not so much in the enormous load of diverse organizational work as in the fact that even within comparatively narrow sections of modern chemistry scientists at times poorly understand each other. What is to be demanded then of the deputy director of a general institute or the prorector of a large higher educational institution?

Of course, the administration and scientific councils have a certain influence on the formulation of themes, being guided by specific scientific and competitive considerations; the administration manages financing, personnel and material and technical supply. And still in the end the choice of the direction of basic research is under the jurisdiction of the manager of the scientific group. How is one to see to it that the choice made by this manager would be the optimum one?

It is well known that every scientific direction passes in its development through three stages.

At the first of them, the latent stage, the origination of the direction, which is still invisible to the scientific work, occurs. Individual scientists, who, as a rule, are not yet acquainted with each other, are concerned with it. Publications and patents also still number only a handful.

The second stage is a period of rapid growth. Universal attention is attracted to the new field, the flow of articles and the number of researchers, who join in the new direction, increase exponentially.

Finally, the third stage is the phase of saturation. The basic results have already been obtained, their specification and augmentation occur. The number of scientists, who are engaged in the no longer too fashionable direction, is very large, but the specific contribution of each one is negligible.

The modern science of science makes it possible to establish at what phase of development a given scientific direction is--at the second or the third. It is clear that in case of the choice of basic themes it is advisable to direct attention to the actively developing areas of science and there is no point in spending efforts and assets on work which is already at the phase of saturation. It is better to take part in a direction, which is in the second phase of development, and even better--in the first. But what is one to do with the first phase, which the science of science can judge only "in retrospect"?

It is here that the scientific leader also needs uncommon perspicacity. Perspicacity (according to V. I. Dal "a clear understanding of the future") constitutes in our times the subject of an independent scientific discipline--prognostication, which is based on three techniques: the carrying over to the future of observable trends, modeling and expert evaluation.

In order to find the most urgent problems by the analysis of today's trends of the development of science, it is necessary first to formulate these trends.

The following traits are first of all characteristic of natural science of our times: the integration of the sciences, as well as the carrying over of the methods and notions of one scientific discipline to the lap of another; the automation of the scientific experiment, the extensive use of computers and microprocessors in scientific research; the development of physical methods of research.

The listed trends are of a very general nature and therefore can hardly be used for the formulation of specific scientific problems. However, even such an approach makes it possible to conclude that other things being equal the ideas, which encompass related fields of knowledge, are more fruitful; that, for example, bio-inorganic chemistry is the front line of natural science; that it is desirable to earnestly teach biology and even medical students mathematics and physics; that it is necessary to develop intensively scientific instrument making and to spare no money on the acquisition of good instruments.

Now let us examine several more specific trends which have a direct bearing on chemistry.

1. The gradual depletion of fossil organic raw materials will also continue in the future--consequently, the research in the area of the search for means of activating CO_2 is urgent.

2. Mankind needs new energy sources--hence, it is necessary to study the processes of obtaining hydrogen from water by means of sunlight.

3. An ecological crisis threatens (and, apparently, for a long time to come will threaten) the planet: there is the need for the organization of research on the complete use of raw materials and the development of low-waste and waste-free processes.

Let us direct attention to the fact that in this case as well the noted trends are of a most general nature. Indeed, we cannot give precise recommendations not only on how to bond CO_2, but even on what means is preferable: the modeling of photosynthesis, the development of plasma chemical methods or the study of chemical absorption in heterogeneous complex metal catalysts. But, perhaps, there exist some other method, which for the present no one knows, of involving CO_2 in organic synthesis?

But by continuing to study the trends of development of each of the directions by the method indicated above, it is possible sooner or later to find a theme which is worthy of being studied.

The analysis of trends is applicable only for the areas of science, which are close to the demands of practice. It is advisable to predict basic research by the method of modeling, which consists in the analysis of the dynamics of the development of models of science with the use of charts of the scientific directions.[1]

This method is based on the calculation of the number of connections between highly quoted articles, that is, gives information on scientific directions which have already appeared. Consequently, it is possible by means of it to identify reliably the scientific directions which are in the second phase of development--the stage of rapid growth. This method is hardly suited for the forecasting of the development of problems, on which one or two publications will barely be found.

The method of expert evaluation can be used for a forecast at any phase of the development of a scientific direction. It is being used extensively throughout the world: the experts--prominent scientists, who list the important, in their opinion, directions of research, give the initial information for the planning of science. Of course, each individual scientist, like any person, is not insured against mistakes and might not appreciate a truly promising direction or might overestimate the importance of a direction which is not capable of yielding valuable results. However, the evaluation is made by a large collective of scientists, the possibility of gross errors is reduced substantially.

A debate on the theme of how the labor of a scientist should be evaluated flares up periodically in the press. If a scientist is engaged in applied research, everything is quite simple: the result of his labor makes an appreciable contribution to the production of physical assets--he develops a new device, a new material or a new method. But with the evaluation of the labor of scientists, who are engaged in basic research, the matter is much

more complicated: they produce a single product--scientific articles which it is possible only to read.

The most diverse publications: from local collections to central journals of the USSR Academy of Sciences and journals of an international nature, publish scientific works. And it is hardly worth disputing the fact that scientists draw up a professional opinion of each other (and, hence, mutually evaluate their own labor), precisely by reading what has been published. Here the multitude of scientific publications forms a hierarchical structure: even quite callow graduate students know that it is of greater prestige to have a work published in an academic journal than in the sectorial journal, while a departmental collection, as a rule, is considered "more recognized" than a collection of works of N institute. While to have a work published in a journal like DOKLADY AN SSSR or, say, NATURE is entirely the limit of dreams.

The reason for this is extremely simple: in the majority of central journals the materials sent in undergo exacting review (if only simply for the reason that manuscripts are received in abundance by such journals), as a result of which only the strongest works get into print. In journals of less prestige the reviewing is of a superficial nature, while in many local collections it is entirely formal, and therefore their pages are cluttered with weak, but numerous little articles which create an information din. (Let us note in parentheses that, in spite of the obvious defectiveness of the evaluation of the labor of scientists by the total number of publications, this practice is alive to this day.)

Thus, for the making of an expert evaluation of new scientific directions (in accordance with the first articles or even in accordance with annotated applications for themes being opened) it would be possible to enlist members of the editorial boards and reviewers of central specialized scientific journals. Of course, for this one would have to draft a statute on evaluation, enlarge the editorial boards, approve lists of nonsalaried reviewers and so forth. For the purpose of increasing objectivity it would be possible to enlist in the evaluation of each application two or three specialists, whose criticisms would be discussed at a meeting of the editorial board. A positive evaluation would mean the quick publication of the article and (or) the obtaining of the right to the priority financing of the work; a negative evaluation would speak for itself.

The distinction of the system being discussed from the evaluation of the Higher Certification Commission consists, first, in the fact that it would be more narrowly specialized; second, in the fact that the Higher Certification Commission analyzes already prepared works, on the fulfillment of which each author spends not less than 3 years (and more often from 5 to 12 years), while the editorial boards could examine the proposals at the moment when they are still, so to speak, in an embryonic state.

Thus, a collective assistant--specialists who are grouped around the leading scientific journals--can be offered to the leader of a group when choosing themes. The drawback of such a method of evaluating themes is clear: it is impossible to establish the truth by a majority vote.

Several other methods of evaluating the promise of new directions are known, but each of them has obvious shortcomings.

The Historical Method. Having studied the logic of the development of one narrow area of chemistry or another, in principle it is possible to establish the laws of the emergence in it of urgent problems and to use them subsequently as applied to today.

Unfortunately, one has not had occasion to hear about successful results of the practical application of this theoretically possible method.

The Bionic Method. Living nature is an inexhaustible source for imitation, and therefore the deciphering of the mechanisms of the functioning of living systems usually fruitfully influences the natural sciences. Suffice it to recall the modeling of enzymes, homogeneous catalysis, the bonding of atmospheric nitrogen and so on.

But in technology there exists a host of processes which do not have analogues in living nature.

"The Limit Method." Its essence consists in the fact that when examining a new application for a study the ideal ("limit") result is analyzed and it is ascertained what the work being planned promises in the best case. The range of such abstract results can be broad: from the modest revision of several figures in a reference book to the discovery of new laws of nature. If several ideas are in the competition, it remains merely to choose the most promising one. Here it is necessary to take into account that the probability of the realization of forecasts is small, although it may also turn out that the revision of figures will lead to a major discovery: let us recall, for example, that inert gases were discovered by the precision measurement of the density of atmospheric nitrogen. (True, pessimists are inclined to direct their attention to the worst result.)

Reliance on the Leader. In the opinion of many famous scientists, this technique often justifies itself: if you have several associates, each of whom suggests his own version of the themes, while it is possible to support only one, support the go-getting and, wherever possible, the likeable one.

Of course, it may also happen that the idea of the most awkward person was stronger and more fruitful. Then the go-getter will see the matter through. It is for you to decide what is better.

Thus, the final conclusion would seem to be distressing: there is no faultless formalized tactic which takes the place of the intuition of the scientist when choosing basic scientific themes.

But what is actually regrettable about this? So it should be! The choice of themes and the generation of ideas are the most creative act, which is within the capacity of far from everyone. For the optimum choice of themes it is necessary for the manager of a group to have great professionalism and strong intuition--the ability to make the correct decision when there is insufficient

information. Moreover, he should not forget the ethical aspect of scientific work.

Consequently, the strategic task consists not in inventing artificial rules of the choice of urgent directions, but in choosing and fostering talented young people, in increasing the level of education and in creating conditions which are capable of ensuring the promotion to the management of scientific groups of genuine honest professionals. Then the problem of choosing urgent basic themes simply disappears.

FOOTNOTE

1. S. G. Kara-Murza, KHIMIYA I ZHIZN, No 11, 1981, p 8.

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ORGANIZATION, PLANNING AND COORDINATION

INTERCONNECTION OF ACADEMIC, SECTORIAL, PLANT SCIENCE

Moscow SOTSIALISTICHESKIY TRUD in Russian No 3, Mar 85 pp 24-33

[Article by Doctor of Economic Sciences Professor G. Lakhtin: "Scientific and Technical Progress and Science: Academic, Sectorial, Plant"; passages rendered in all capital letters printed in boldface in source]

[Text] On the threshold of the 27th CPSU Central Committee Congress, at which the vital questions of the acceleration of scientific and technical progress will be discussed and the corresponding decisions will be adopted, it is appropriate to return to the examination of the reserves and possibilities of the increase of the creative contribution of scientists and designers to the development of social production. Common organized efforts in the end will decide the success. Here it is important that two lines would merge: one, which runs from administration, "from the top," and another, which runs "from the bottom," from everyone who is engaged in the development and introduction of the achievements of science and technology. All the basic factors here are closely connected and depend on each other: the content of the work (the themes) predetermines the methods of research; in turn, the forms and means of stimulation in many respects depend on them. In tracing this chain, it must be borne in mind that scientific and technical activity is nonuniform. On the path from the scientific idea to the production innovation both the methods and the stimuli change substantially. What is important in academic science might not be of substantial importance in plant science. Therefore it is expedient to examine the basic units of the science-production cycle separately with allowance made for their specific tasks.

THE FIRST LINK IS ACADEMIC SCIENCE, which is oriented first of all toward basic research, which should yield new knowledge, new initial ideas (both for further scientific searching and for applied research and development). Nevertheless we more and more often come across reports about how the collective of one academic institute or another developed and introduced at a plant a new instrument or process. The proposals on the implementation of the results, which the USSR Academy of Sciences turns over to the USSR State Committee for Science and Technology and ministries, are estimated in the thousands.

Although a clear distinction, which is determined by organizational affiliation, exists between academic and sectorial science, it is difficult to

draw a line between basic and applied research. In essence we do not know precisely what share basic research makes up in the general scientific balance. A study can be started and the theme can be formulated as a purely theoretical one, and therefore they assign it to the category of basic research. However, having identified, for example, the theoretical characteristics of the propagation of a blast wave, the scientist immediately sees the possibilities of their practical applications, say, for the uniting of parts by explosion. Did the work become less basic because of this? No. And it is now impossible to call it purely theoretical, although this is also not a development which makes it possible on the basis of already known principles to create a new technical object.

This is by no means an idle dispute about names, since the solution of many problems, up to the stimulation and the organization of the remuneration of labor, depends on its outcome. As it seems to us, a boundary all the same exists here. But one should draw it not between the themes in accordance with their names in the plan, but within them between the individual operations, which are distinguished according to their goal orientation. It is possible to explain such a distinction on the basis of the example of the difference between a discovery and an invention. A discovery gives us a scientific explanation of what has always existed (for example, universal gravity). An invention creates what previously did not exist (the motor, the electric light bulb). It is natural that elements of basic and applied research can frequently be combined within one theme.

Seeing the possibility of practical applications of a theoretical result, the individual representative or collective of academic science can act in two ways: either turn the discovery over to a sectorial institute or bring it up to practical implementation on its own. It is customary to believe that the former means predominates and, in our opinion, they represent it as too smooth: basic results are perceived, transformed and so on. In practice on the average only 5-6 percent of the operations of sectorial scientific institutions have been initiated by achievements of academic science. There are many reasons for this: organizational isolation (the lack of a common management and coordinating organ), the desire to preserve priority, distrust of the scientific forces of sectorial institutes and so forth. Therefore academic institutes more and more often conduct not only research, but also development. The appropriate infrastructure: a design bureau, pilot plants and so on, is needed for this. And academic institutes are becoming overgrown with such subdivisions and, hence, their specialization in basic research in practice "is being eroded."

The increase of the amount of contractual operations, which are performed for specific clients, each of whom is pursuing his own quite practical goals, in many respects "aids" this. In the past 15 years the share of contractual operations in academic science as a whole has increased by threefold. This process is occurring especially intensively at the republic academies, where in a number of cases it has increased to 60 percent.

It is possible to explain the increase of the applied nature of the work of academic institutions also by the fact that a certain freedom from sectorial dependence and the restrictions, which are connected with it, is achieved at

them. Intersectorial research is needed either in those instances, when the joint work of many institutes, which represent different fields of knowledge, is required for the development of an important innovation or when many departments need the results of the work. For example, the processes of the regulation of heat exchange, electroplatings or welding exist in many industries, at enterprises of tens of ministries. An organization of not a departmental, but a problem nature, to which an academic status is conducive, is needed for the elaboration of such themes.

It is important to point out that research themes are not equivalent. Along with fundamentally new solutions, which lead to revolutionary changes in production, a large number of minor themes, which solve special, local problems which are usually connected with the improvement of operating equipment and technology, are being fulfilled. The status of academic institutes is conducive to the performance of major operations, since first of all a new principle, which originates precisely during theoretical research, is needed for fundamental innovations, as well as because such developments are, as a rule, intersectorial.

Under these conditions the role of academic science as a system, which is oriented toward purely theoretical research, is changing substantially. It is gradually being transformed into a system which can be distinguished with respect to not less than three attributes: basing on a theoretical foundation, the performance of operations of great national economic importance, their intersectorial nature. The participation of academic institutes in comprehensive scientific and technical programs can serve as confirmation.

One should hardly be distressed with regard to the fact that the contact of academic science with practice is growing stronger. This is an objective and natural process. Another thing is important--to see all the consequences of this process, to develop positive trends and to seek means of overcoming undesirable ones. Among the latter let us note first of all the decrease of the share of theoretical operations.

The increase of the share of research, which provides a practical return, yields a gain relatively quickly. But if it is achieved by the decrease of the theoretical reserve, such a gain today can turn into a great loss tomorrow. Therefore it is important to take into account and to maintain the necessary balance between the amounts of basic and applied operations, and if necessary to offset the "enthusiasm" for applied themes by increasing the number of workers who are conducting theoretical research. Where is one to get these forces? It seems to us that it is possible to do this by means of sectorial science, having thereby compensated for the expenditure of those forces of academic institutes, which are used for the solution of problems of an applied nature.

The proposed shift also has another goal. As was noted, academic science is a conducive place for the fulfillment of operations of great national economic importance, which have an intersectorial nature. The number of such operations and their share in the total amount are steadily increasing, while the boundaries of the academic and sectorial systems and the distribution of

personnel between them remain the same. In other words, the organizational structure lags behind the substantial aspect of the activity of scientific institutions. The organizational system in science, which has been centralized on the scale of the state, in our opinion, should also be in keeping with operations of statewide importance.

If we assume that the influx of resources into academic science will be ensured, it is also important to determine how to use it. In recent times, when the staffs were increased, the increase was aimed mainly at the development of the infrastructure (design, pilot and other subdivisions), that is, in the direction of the development of the "applied aspect" of science. It seems to us that it would be more correct to develop academic science by the establishment of new units with a purely theoretical orientation for newly arising problems. And here, apparently, for some time it is not worthwhile at all to require of them an economic impact and specific practical results. Here, obviously, other forms of control are needed.

One should also take into consideration the penetration of elements of cost accounting into academic science. Hence, too, the aspiration to evaluate the results in terms of a monetary equivalent. But the exaggeration of the role of the monetary evaluation frequently has the result that the lack of an economically calculable result acts as the lack of any result and therefore the distinction between operations, which are valuable, although for the present they also do not have an immediate economic impact, and fruitless theorizing is erased. Stimuli, which are directly connected with the practical return, especially as it is obvious, more easily measured and, at first glance, more useful, are appearing. Therefore it is so important that they would be balanced by stimuli which induce one to conduct precisely theoretical research. Here one should proceed from the basic task facing sectorial science, which, so it seems to us, can be formulated at follows: to maximize the theoretical results, without overlooking as far as possible the associated practical applications.

From the standpoint of the priority of the theoretical return of academic science, obviously, one should also decide which stimuli are needed in order, first, to attract scientists to it and, second, to induce them to work with the greatest possible effectiveness.

Scientific personnel are distinguished from all other personnel by the fact that the existence in these people of some innate qualities, which it is possible to designate briefly as "the talent of a researcher," is presumed. Gifted people are rare, and the problem of the personnel reinforcement for science will always be solved by searching and selection. How are these searching and selection to be carried out? No tests, which would make it possible to confidently identify gifted people, as yet have been devised. Scientific work itself acts as the only reliable test. As a rule, 2-3 years of work in a laboratory under the supervision of experienced senior comrades are enough for it to become obvious whether to expect a scientific return or not. Incidentally, the introduction of the position of trainee pursues precisely this goal. And in general the first 2 years of work of a young research should, apparently, be regarded as a trial period. Moreover, for the

young portion of the scientific contingent it is advisable to intensify substantially a kind of selection.

At present for junior associates certification in most cases is an easily surmountable formality. They reason approximately as follows: "They are too young to get something from them." Moreover, in practice they do not solve important problems, but carry out what has been assigned. Probably, substantial changes are needed here: it is important to thoroughly understand young people, to select those who are capable of scientific work and think independently, in order then to grant them more quickly the freedom which is necessary and possible within the general planning and organizational study. Then their growth will also be ensured and hastened.

But in order to make a selection, it is necessary to have a choice. Meanwhile in recent years not only the competition for technical higher educational institutions and natural science faculties, but also the total number of those desiring to work in science have decreased. The honor of a job at academic institutes is no longer a sufficient stimulus, the material aspect is also important. At present at academic and sectorial institutes the system of the remuneration of labor is similar, with the exception of the fact that at academic institutes there are no regular bonuses. The ones that exist are connected primarily with applied successes. The wage at the initial levels of the job ladder is small. A significant increase is achieved at the level which corresponds to the transfer from an individual job to the management of a group or subdivision. If, as was noted above, it is advisable to strengthen the strict selection at the initial stages of a scientific career, then, obviously, it would also be worthwhile to reinforce it by a more appreciable "threshold" in the remuneration of labor in case of a transfer from trainees to researchers. But precisely this transfer should be accompanied by such an increase of the wage, which would attract young people, in spite of the risk of not making it through the selection.

It is no less important to decide how to link the remuneration of labor with the success of current work. In theoretical science many years are frequently spent on patient progress without a visible return. Moreover, the following also frequently happens: results have been obtained, but their value at first is not obvious. Here for the present there are no ready-made solutions. But it seems to us that it is necessary to attempt first of all to estimate the theoretical scientific impact in much the same way as we estimate the potential economic impact. Given objective estimates it will be the job of technology to establish a direct connection between them and the remuneration of labor in the form of regular bonuses or salary increments.

THE SECOND LINK IS SECTORIAL SCIENCE. The scientific research, planning and design and technological organizations, which belong to industrial ministries, are included here. This is the largest detachment of our science--more than 50 percent of those employed in it. The main goal of sectorial science is the elaboration of technical decisions which lead to the improvement and transformation of production. In this sense sectorial science as if continues the chain of research, starting with the "product" of the basic sciences and ending with the assimilation at enterprises of new equipment or technology. The functioning of these scientific subdivisions in the structure of

ministries is responsible, on the one hand, for the closeness to production and the knowledge of its needs and, on the other, the subordination to them, which is not always desirable. In order to help to clarify the social role of sectorial science, we will compare two points of view.

One of them recognizes as production only such a function as the manufacture of the product for the sake of which it was developed. All types of production activity (technical control, labor safety procedures, supply) are aimed at promoting precisely this function to ensure the fulfillment of the production plan. They also group here applied science, regarding its activity as akin to the activity of supply and auxiliary services. Hence, too, the aspiration to subordinate it to the interests of current production. In practice this turns into work on minor themes: attention is focused on the elimination of "tight" spots and other current disorders.

The alternative position is that the current output of products and scientific and technical development are two independent, but closely connected aspects of modern production. The enterprise was actually set up for the output of a specific product, but, being engaged in this work, it cannot and should not remain unchanged. Its product will inevitably lag behind the socially acceptable level (both in cost and in technical development). So that this would not happen, the enterprise should continuously improve its technology, decrease the cost and improve all the qualitative characteristics. And these changes, which are fed by the influx of scientific and technical innovations, occur regardless of the current output of products and frequently oppose it, especially as the plans on the output of products and the introduction of new equipment exist separately, and the former are fulfilled, while the latter are far from always fulfilled.

Although the latter position is recognized in words, in practical actions the former, as before, predominates. Sectorial science is overburdened with the fulfillment of a large number of operations, which serve as a help to current production. And meanwhile no one will deny that scientific and technical progress is an evolutionary-revolutionary process, it combines the gradual improvement of existing equipment and technology and major innovations which lead to revolutionary changes in equipment.

Of course, it is impossible to count only on technical revolutions, while rejecting the possibilities of an enormous saving due to the complete use of operating equipment and the realization of all its reserves. But one must also not exaggerate the possibilities of evolutionary development. This would mean "to catch up, without surpassing," that is, to always be second. The speeding up of scientific and technical progress implies an orientation toward the preferential development and introduction of innovations of a revolutionizing nature. This is also the concentration of forces on the key tasks, which is spoken about in party documents.

Consequently, the question of the themes of sectorial institutes is no less important than the question of the directions of basic research. The increase of the proportion of highly important operations will not occur by itself, since a large number of circumstances: a rapid impact, fewer difficulties with introduction and others, work in favor of minor themes. In order to

manage themes, it is necessary first of all to find a means of differentiating between operations according to importance, and perhaps to introduce this indicator (levels, groups) officially. Then it will be possible to carry out the certification of the operations, which are performed by sectorial institutes, for example, when evaluating the activity of the institutes to take into account the share of operations of the highest category of importance: when categorizing the institutes to take into account first of all the themes. The institute cannot be responsible for the formed situation at the works associated with it, but can and should be responsible for its own efforts on the scientific and technical development of this works.

With allowance made for the above-cited considerations the basic task of sectorial science, in our opinion, is to maximize the production result, which consists in the improvement of the product or in the improvement of the process of its production, and not only in "one's own" sector, but also outside it. The boundaries of the useful effect of the results of research in each case are determined by the scale of intersectorial relations.

One of the most important differences between basic and applied research is that theoretical results are used here, in the sphere which gave rise to them, as starting points for new research. The achievements of an applied nature are transferred to the production sphere, and only there does their actual value appear. This cannot but affect the approaches to stimulation. Obviously, the remuneration of labor in sectorial science should be organized in a different way than in academic science.

For the personnel, who are engaged directly in scientific research and experimental design work, it is natural to seek a means of linking the amount of remuneration of specialists with the practical result for the theme and with his personal contribution to the success. Therefore thematic remuneration cannot act as the basic form of remuneration for labor. The wage or, more precisely, the salary remains such a basic form.

At present the salary of scientists is connected first of all with the position and, hence, everyone links the increase of pay with a promotion, which, in turn, in many respects depends on the existence of vacancies. However, for sectorial science an appreciable quantitative increase in the foreseeable future is impracticable. The freezing of the size of the staff at the same time also signifies the freezing of the organizational structure. New positions of senior scientific associates and managers of laboratories, sectors and departments are not foreseen, while the available ones are firmly occupied. On what increase of the wage can a young scientist, who is beginning his official duty at a scientific research institute, count? In his eyes the prospect of an increase in an acceptable time seems even more essential than the low salary at present. And when there is no such prospect, he has the right to seek another place for the application of his strength and abilities, not at the scientific research institute.

It is impossible to recognize such a movement of personnel as efficient, especially as the number and scale of scientific and technical problems will increase and they have to be solved mainly by means of the available forces, more precisely, without an increase of the number of workers. Therefore the

qualitative growth of specialists, especially young specialists, is so important. It implies an increase of skills, which leads to an increase of the useful return and also merits a reward and incentive regardless of the position.

Thus, if the quality of the labor of specialists and its efficiency increase, this should find reflection in the pay. And here two independent directions (means) of the increase of the salary appear: one is connected with the position, the other is connected with skills. Those who have the organizing abilities and other qualities, which a manager needs, will advance more rapidly up the job ladder. But the increase of skills far from always depends on the position. A worker may remain a senior laboratory assistant, but the accumulation of experience, knowledge and practical skill, which make it possible to master new methods of research quickly and accurately, should also, in our opinion, be accompanied by the increase of skills and the corresponding change of the salary.

Such an incentive for skills is now in effect in a very limited form, since in fact there are only two skills levels: the academic degrees of candidate of sciences and doctor of sciences. Qualitative growth is recorded in conformity with these fixed standards, the reliability of which is guaranteed by the state system of the certification of scientific personnel. The limitedness of the effect of this stimulus also appears in the fact that it affects only a portion of the participants in scientific and technical progress, namely those who are regarded as scientists. Designers and planners, for example, are not included among them.

At one time suggestions on the abolition of "the payment for a degree," that is, on the abolition of the dependence of the wage of scientists on an academic degree, were expressed and once in a while are now being made. Such suggestions seem groundless to us. For then the official means of growth for them in general would remain the only one. Under present conditions this would mean to deprive science of material stimuli.

In our opinion, on the contrary, under the formed conditions, when in the development of the personnel potential of science the qualitative, skills growth of the workers employed in it is playing more and more the basic role, not two, but at least five-six skills gradations are needed. Here it is important for the stimulus in the form of a wage increase to be both achievable and appreciable.

It is easy to compile a table (matrix) with a two-dimensional scale (with respect to positions and levels of skills). It is much more difficult to make it "work" as a tool of stimulation. The main thing is to evaluate objectively the labor of each person. Therefore it is advisable to link the certification of an associate not with a specific calendar period, but with the completion of a theme. Positive results will serve as the basis for transfer to the next skills category. The results of inventing activity, resourceful suggestions, publications, which contain theoretical generalizations, and others can additionally be taken into account. An increase immediately by two levels is possible for achieved results which are especially important.

Thematic bonuses act as an additional tool for the organization of stimulation for high results of labor. Their peculiarity consists in the fact that the connection of the results and the reward appears here directly. However, they make up a very small share in the total wage and do not serve as appreciable stimuli. Apparently, it is expedient to increase the amounts of these bonuses by the decrease of the periodic (quarterly) bonuses, which in most cases have turned into a stable, nearly inalienable addition to the wage.

THE THIRD LINK, which in our times deserves independent analysis, is PLANT SCIENCE. It is possible to regard it as a component of sectorial science: within the ministry the scientific research institutes and design bureaus, which are subordinate to it, constitute the centralized part, while plant research laboratories and design bureaus constitute the decentralized part. As on the scale of the country it is possible to pose the question of the optimum proportions between the centralized (academic) and decentralized (sectorial) parts, so in each sector it is appropriate to analyze the analogous relationship. This especially applies to the sectors which it is customary to call science intensive (electrical engineering, radio engineering, instrument making).

How is the best combination of scientific and technical activity and production activity to be ensured in different sectors? At one time there was a dispute: Are the plants to be subordinate to the institutes or the institutes to the plants? In the sectors, in which progress requires constant great scientific and technical efforts, it is actually appropriate to have at the plant if not an institute, then a strong research laboratory. In the sectors with a low science intensiveness it is better, apparently, to centralize scientific forces, having concentrated them at sectorial scientific research institutes.

As a whole about 1.2 million people work in plant laboratories and design and technological subdivisions. The forces are considerable. However, the functions of these subdivisions are specified vaguely, the themes are often unknown to the ministries and therefore the performance of operations is poorly checked. Most often they serve at enterprises as kinds of "fire brigades," which they throw into the elimination of arising production disorders. Their supply with modern research equipment is inadequate, the premises are crowded. But meanwhile the peculiarity of the status of plant science gives it a number of advantages: the greatest proximity to the service works, the urgency of themes, staffing with personnel from the given enterprise, the interest of the plant management in rapid introduction.

The experience of the best collectives--the representatives of plant science--attests that a portion of the workload of sectorial scientific research institutes and design bureaus can be transferred to them. The differentiation between spheres of activity will become sufficiently clear, if the significance test is made the basis. Then the plant sector of science will focus attention and forces on the solution of problems, which are connected with the improvement of operating equipment and technology, that is, on what for the sectorial scientific research institute is work on minor themes, but for the improvement of current production is very, very important. For this it is advisable to channel a significant portion of the assets, which the

enterprises now spend in accordance with contracts with institutes of their own sector, into the development of plant research laboratories and accordingly to make changes in the overall legal status which determines the tasks of the scientific and technical subdivisions at the enterprise, in order to protect them from the performance of functions, which are not characteristic of them, in particular, from being errand boys.

Since plant science is a very little studied object, a detailed analysis, the goal of which is to ascertain what the operations performed up to now are, what the degree of the use of their results is and what the interaction with the scientific research and design organizations of one's own sector and outside it is, should precede such measures. What are the plant subdivisions of science: their personnel composition, technical equipment and structure of expenditures? How is the labor of workers rewarded? Only after this will it be possible to decide how the research work should be best organized at the enterprise--concentrated in one laboratory or distributed among groups by shops and types of production, to whom it should be subordinated, what it is necessary to do so that production workers would be interested in being transferred to the plant laboratories and in working at them to full effect. The obtained data will help with greater certainty to judge what portion of the assets should be channeled into plant science and what to expect from it.

Thus, we link the intensification and stepping up of the scientific and technical activity at enterprises with changes in the substantial aspect, namely with the transfer to the plant sector of science of a portion of the operations which are necessary for evolutionary progress. This does not rule out, of course, the participation of plant researchers in the development and introduction of important innovations, which have been proposed by central institutes, and in the fulfillment of the assignments of scientific and technical programs and other major operations, but should not prevent plant science from solving its own problems.

The aim for plant science can be formulated as follows: to maximize the economic impact from putting production reserves to use on the condition of the preservation or improvement of the social factors of production. The system of stimulation should also be organized in conformity with such an aim. It is advisable, in our opinion, to establish the same salaries for plant researchers as for the engineering and technical personnel of basic production of the same skills and to link the bonuses not with the fulfillment of the current plant (as is the case for production workers), but with the fulfillment of their own assignments and to the extent of the achievements which are measurable by the corresponding economic indicators.

PHYSICAL PRODUCTION IS THE FINAL LINK in the chain, which stretches from science to this practical application. It has already been pointed out above that the modern enterprise acts both as the producer of products, who fulfills the plan with respect to their volume and range, and as a participant in scientific and technical progress, the completing link in the science-production cycle. Current output gravitates toward the stability of all the factors of production (technology, equipment, personnel, supply, as well as products). Scientific and technical development, on the contrary, presumes first of all the dynamicness, the mandatory updating of both the products and

the means of their production. A certain contradictoriness appears already at the stage of planning: any major technical reorganization really threatens the plan of the output of products; the plan on new equipment willing or not is pushed aside, if difficulties with the production plan arise. Here the forces of the parties are not equal, and usually the concern for the fulfillment of the quantitative indicators gains the upper hand, while scientific and technical development suffers. Such a situation is maintained as a result of the fact that the measures of responsibility, the system of stimuli and even the psychology of production workers are traditionally disposed in precisely that way. Subjective manifestations (the conservatism of individual managers, a negative attitude toward innovations) merely reflect the objective original cause, namely the actually opposite direction of the two most important components of the economic mechanism.

Moreover, scientific and technical development influences differently the economic indicators of the enterprises which develop and use innovations. If the consumer properties of a product remain the same, what is new in the technology provides a saving to the enterprise, which introduces them, and does not affect the user and the subsequent links. Changes in products lead, as is evident, to additional expenditures at the producing enterprise, the user, moreover, the ultimate user, who is frequently removed from the producer by several intermediate links, obtains the impact. Practical experience attests that technological innovations are introduced more easily and rapidly, new items are assimilated with greater difficulty. This means that the peculiarities of the labor of collectives of enterprises, which are engaged in the development of new types of products, are not properly taken into account in the economic mechanism and the incentive systems.

The noted conflict between the producer and the user shows especially pointedly, if they are organizationally dissociated and belong to different ministries. It is well known, for example, that in most cases the production of machines and their use are in the hands of different ministries (for example, at enterprises of the Ministry of Chemical and Petroleum Machine Building they design and produce equipment for enterprises of the Ministry of the Chemical Industry). Such an organizational structure does not hinder current production, but frequently complicates the pursuit of a comprehensive technical policy.

There are also sectorial differences in the development and use of scientific and technical innovations. In the extracting and raw material sectors technological processes are primarily improved and updated. Soda remains soda and copper remains copper, no matter how the technology of their production changes. In the processing sectors, which produce machines, instruments and other items, progress proceeds to a greater extent along the line of the updating of products, although, of course, the technology of their production is also improved. Hence, the interests of sectors with respect to innovations are different. Judging from the statistics of inventing, the overwhelming majority of inventions pertain to the class of devices. In other words, the trend of scientific and technical progress, which involves the improvement of products, predominates, that is, that type of production situations, when the introduction of innovations does not conform to the interests of the introducing enterprises or the sector behind them, predominates.

The fate of innovations also differs subject to their scale and importance. The most important ones, which are connected with revolutionary changes of technology (the production of steel without a blast furnace) or equipment (nuclear machine building), require the designing and construction of new enterprises. The more minor ones are introduced directly in operating production. In a number of cases both are included in the plans of enterprises being built or in the designs being developed. Consequently, along with the "science--equipment--current production" cycle there also exists another more complex and lengthy one, "science--equipment--designing--capital construction--new production." Designing plays the decisive role here, since the decision on whether or not to include the given innovation in the design is made precisely at this stage. Preference can be given to already operating tested equipment, since this does not involve risks. The procedure of remuneration also acts "against" new bold solutions. The point is that introduction makes it possible to calculate the economic impact (since a prototype in the form of the equipment being superseded exists) and accordingly to obtain the right to remuneration. In case of introduction after the stage of designing it is possible to calculate only the conditional impact (what would have been, if the former technical solution were used). But for obtaining remuneration it is necessary to determine the actual impact, which in this case defies calculation. There is here also a large field of activity for analysis, since it is very important to ascertain what factors check the use of the latest technical solutions in designs.

All this attests to how complicated the problem of implementing scientific and technical achievements in production is and to how diverse and dissimilar its components are. It is necessary to improve the organizational economic mechanism of the acceleration of scientific and technical progress with the maximum consideration of the peculiarities of the problems which are being solved by each of the sectors of science.

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ORGANIZATION, PLANNING AND COORDINATION

MANAGEMENT OF INNOVATION PROCESS UNDER ECONOMIC INTENSIFICATION

Moscow EKONOMIKA I MATEMATICHESKIYE METODY in Russian Vol 21, No 2, Mar-Apr 85 (manuscript received 12 Oct 84) pp 201-210

[Article by B. D. Motorygin (Moscow): "The Tasks of Improving the Management of the Innovation Process Under the Conditions of the Intensification of the Economy"]

[Text] Among the most important tasks of the development of the national economy of the country the intensification of social production, the main lever of which is scientific and technical progress (NTP), is the central one. The use of qualitatively more advanced and efficient machines and equipment and the latest technological processes is making it possible to decrease the expenditures of living and embodied labor.

The classics of Marxism-Leninism repeatedly indicated the objective increase of the significance of science. "Whereas the process of production," K. Marx wrote, "is becoming THE APPLICATION OF SCIENCE [in italics], science, on the contrary, is becoming a factor, so to speak, a function of the process of production" [K. Marx and F. Engels, "Soch." [Works], Vol 47, p 553]. In our times this theoretical conclusion is being convincingly confirmed. Annually more than 4 million inventions are introduced in the national economy, about 4,000 new types of machines, equipment, devices and instruments are assimilated in production. Just by the implementation of measures on new equipment about 550,000 workers are conditionally freed annually, about 5 billion rubles are saved. Inventing activity is leading to approximately the same result [1, p 129].

Progress in the area of science and technology is making a decisive, moreover, an increasing contribution to the development of social production, which is appearing first of all in the increase of the productivity of national labor.

The increase of the influence of science on social production presumes, first of all, the stimulation of their interconnection. "The country has the extreme need," it was emphasized at the 26th CPSU Congress, "that the efforts of 'large-scale science,' along with the elaboration of theoretical problems, would be concentrated to a greater extent on the solution of key national economic problems, on discoveries which are capable of making truly revolutionary changes in production" ["Materialy XXVI syezda KPSS" [Materials

of the 26th CPSU Congress], Moscow, Politizdat, 1981, pp 42-43]. At the same time as this "...science itself should also be a constant 'disturber of the peace,' showing in what sections standstills and lags have been noted, where the present level of knowledge makes it possible to advance more rapidly and more successfully" [2, p 62].

Owing to the introduction of the achievements of science and technology working conditions are being made easier (in the past decade the capital-labor, power-worker and electric power-worker ratios have been increasing rapidly [1, pp 172, 179, 234]), the quality of the output being produced is increasing.

At the 26th CPSU Congress it was emphasized: "The level of the demands, which are made on product quality,... should be the highest. Conformity to the best world and domestic models--we cannot and should not agree anything less. It is necessary to accustom oneself to this, it is necessary to strive for this, while resolutely rejecting everything that is obsolete and backward and has been discounted by life itself" ["Materialy XXVI syezda KPSS," Moscow, Politizdat, 1981, p 43].

Scientific and technical progress is providing today more than three-fourths of the saving of fuel, energy, material and technical resources. The materials-output ratio of industrial products (in comparable prices) decreased during the 9th Five-Year Plan by 3.7 percent and during the 10th Five-Year Plan by 2.0 percent [1, p 585].

The cited data attest to the increase of the role of science in the development of the productive forces of society and its transformation into a basic factor of the increase of the efficiency of social production. The significance of scientific and technical progress is especially increasing at the present stage in connection with the slowing during the past 10 years of the growth rate of the indicators of social production, with the appearance of bottlenecks in the economy and with the increase of the strain in the material, manpower and financial balances. Among the factors, which influenced the decrease of the growth rate, are the greater and greater exhaustion of the extensive sources of the expansion of production and the slow changeover of the economy to the intensive means of development. For the present the structural reorganization of the national economy is still being carried out at an inadequate pace, the proper balance and proportionality in the development of individual sectors are not being ensured, a lag of the pace of scientific and technical progress in a number of sectors is being observed. The shortcomings in capital construction are being eliminated slowly.

The implementation of the decisions of the November (1982) and subsequent CPSU Central Committee plenums made it possible, starting already in 1983, to improve the basic indicators of the activity of the national economy. Owing to a number of measures on the tightening up of planning, labor and financing discipline it was possible to overcome the tendency for the growth rate of labor productivity and the production of industrial and agricultural products to decrease.

Considerable importance in the solution of the problem of the intensification of social production belongs to the improvement of the management of innovation processes in the national economy. The reform of the prevailing economic mechanism should proceed in the direction of the utmost orientation of associations and enterprises toward the achievement of the maximum national economic efficiency of their work. It is necessary to fundamentally incorporate the indicator, which reflects this efficiency, in the system of the planning of science, technology and production, for which, first of all, more perfect methods of its determination are required.

The national economic impact from the use of new equipment should be no lower than some standard level, which is linked with the planned growth rate of the national income of the country, while the efficiency of scientific and technical progress should be greater than the efficiency of social production as a whole.

The problem of the determination and the extensive use in the planning of measures on scientific and technical progress of standards of efficiency, which link the end results with the expenditures of assets on the implementation of innovations, is today one of the key problems. Such standards in combination with the establishment of the time of the completion of the work and the limits of expenditures by stages of the innovation cycle will help to improve substantially the planning of measures on the development of science and technology. First of all there should be formulated the standards of: the effectiveness of the total expenditures on the innovation cycle; the effectiveness of the capital investments, which are being channeled into the implementation of scientific and technical measures; the financial resources, which are necessary for the carrying out of research and development, the assimilation of the production and the introduction (the assimilation in use) of new equipment.

The lack of standards of the effectiveness of measures on scientific and technical progress at times leads to the appearance in the national economy of unprofitable equipment. The exceeding of the time of the completion of work on the innovation cycle creates conditions, under which in a number of cases new machines and equipment become obsolete already by the time of the start of their production and use in the national economy. The underestimation of the need for the formulation of standards of the expenditures of financial resources by stages of the innovation cycle frequently gives rise to the "freezing" of expenditures at its first stages, the increase of unfinished (not having found introduction) research and development and inefficient expenditures of national economic assets on "worthless" operations. Even with allowance made for the fact that a portion of them are ones which end with a negative result, according to our data, only about half of the completed research and development is implemented in the national economy.

The difficulties in the formulation of standards of expenditures by stages of the innovation cycle consist today in the lack of appropriate accounting. However, the expert evaluation, which was obtained by us, gives the following ratio: for every ruble spent on basic research there are 2.8 rubles, which are spent on applied research, and 6.2 rubles, which are spent on the carrying out of development; while for every ruble of capital investments in research

and development there are less than 5 rubles of capital investments, which are used for the implementation of their results, which is less than in the developed capitalist countries. In this connection it should be noted that at present great importance is being attached to the need for the substantial increase of the share of the capital investments which are being channeled into the retooling of the national economy. The proportion of the investments for the indicated needs in recent years has increased somewhat, but for the present still to an inadequate extent for the assurance of a high rate of the updating of the production apparatus of the national economy. The expansion of the use of goal program methods of the planning of science and technology, the greater and greater orientation toward the technological updating and improvement of production and toward the development of not individual machines, but systems of them, which the producer enterprises should service, the formation of unified development funds in sectorial ministries and departments and many other directions of the improvement of the management of scientific and technical progress attest to the gradual development of a systems approach in case of the solution of the problems of the development, production and use of new equipment. The more complete implementation of this approach will make it possible to choose more effectively the parameters of new machines, including their reliability in operation and service life, and to orient workers toward high end results of the use of the developed equipment at the user's.

For the present a certain isolation of the planning, financing and economic stimulation of the operations, which are performed at the different stages of the innovation cycle, is still occurring. Its relative unity is possible only at the state level of planning by the formulation of goal programs of the development, assimilation and introduction of new equipment and technology in production. However, there is no special system of the financing and material and technical supply of such programs.

What practical steps is it necessary to take for the complete implementation of the systems approach in the management of innovation processes and for the assurance of the continuity of the planning, financing and economic stimulation of the process of the development, assimilation and extensive dissemination of new equipment or technology? The basic ones of them are the following.

In the area of planning the further development of goal program methods and the coverage by them of the entire life cycle of new equipment (technology) are necessary. The all-union scientific and technical programs should be regarded as an integral part of the five-year plans. In prevailing practice the assignments of the programs on the assimilation and introduction of new equipment in production are included in special sections of the state plan of the development of science and technology, which breaks the united chain of the innovation cycle. Moreover, the need exists for the broadening of the horizon of planning in scientific and technical programs. They could contain measures which support the stage of the successful operation of new equipment, up to the removal from production of the types of equipment, which were developed in accordance with the program, and their replacement with more advanced types. The lack in the programs of similar assignments and measures has the result that the user is often not ready for the efficient use of the

new equipment or technology: there are not enough personnel for work with the complex machines; the necessary organizational measures, which make it possible to use fully the advantages of scientific and technical progress and so on, have not been implemented.

The formulated suggestions concern all types of scientific and technical programs which are now being drawn up, including sectorial and republic programs, and the problems of territorial production complexes. The need for a systems approach to the problems in question on an all-union scale makes it incumbent today to solve the problems of the special-purpose financing and material and technical supply of the programs which are formulated at various levels of the management of the national economy. This question has been discussed for a long time, but steps have so far not been taken. True, this problem is itself not one of the simple ones--a certain reform of the system of drawing up statewide and sectorial plans and the singling out in them of special program sections are needed. First of all this concerns the plans of the financing of expenditures on the development of science and technology, capital investments and capital construction, material and technical supply.

In the area of financing from the point of view of the unity of the innovation cycle of the development, production and use of new equipment (technology) it is advisable to make the transition to the formulation of five-year financial plans and where possible to concentrate all monetary resources in special special-purpose funds. The annual planning of financial resources, which prevails at present, limits the possibilities of the 5-year planning of the development of science and technology (and production as well) and decreases the economic operational independence of organizations and enterprises in the spending of assets. The process of the development, assimilation and introduction of new equipment (technology) owing to its specific nature and the lack of strict determinateness needs today a flexible, dynamic system of financing and the broadening of the rights and opportunities of organizations and enterprises in the use of financing resources for the purposes of the technical improvement of production.

The dispersal of financial resources among sources of receipt, which have, as a rule, a strictly special purpose, as well as among ministries (departments) hinders the systems realization of these goals. This complicates the redistribution of assets between the latter and the stages of the innovation cycle and makes practically impossible the monitoring of the efficient realization of the monetary assets which were allocated for the development of science and technology. For example, in 1981 of the 75 billion rubles of profit of industry 3 billion rubles were channeled into centralized capital investments through the development fund of enterprises (this is the first source of financing of measures on scientific and technical progress). Unified funds for the development of science and technology in the amount of 3.6 billion rubles were formed by deductions from this profit (the second source). In the same year the USSR State Bank and the USSR Bank for Financing Capital Investments issued credits for the financing of measures on scientific and technical progress in the amount of 8.9 billion rubles[1] (the third source). The assets of the state budget were the fourth source, the amounts credited to the cost of production--the fifth source. The use of all these monetary assets was not always coordinated, including with respect to the main

indicator--the national economic efficiency of the measures on scientific and technical progress. The measures themselves were not united in a single innovation cycle, for there is no consolidated plan of the technical improvement of production at associations and enterprises.

The opinions expressed by many scientists and specialists on the increase of the efficiency of the use of the assets, which are allocated for the development of science and technology, and their concentration on the solution of problems, which are of great national economic importance, require today the concentration of all monetary resources in at least two sources of financing of scientific and technical activity: the unified fund for the development of science and technology (current assets) and the fund for the technical development of production (capital investments in science and technology). They should be formed on a cost accounting basis, while the enterprise (association) should be granted significantly more extensive rights in the use of the indicated funds. It would be possible to centralize a portion of them in the ministries for the fulfillment of scientific and technical measures, which are of a sectorwide nature, and in the USSR State Committee for Science and Technology for the financing of all-union special-purpose scientific and technical programs. Owing to this the economic operational independence of associations (enterprises) in the use of the assets, which are released for the development of science and technology, will be broadened, while the central organs will get in their hands a mighty lever for the management of sectorial and intersectorial scientific and technical programs.

The idea, which is being voiced by many scientists and specialists, of organizing a unified centralized bank of scientific and technical development for the concentration in it of all the financial resources, which are being channeled into the development, assimilation and introduction of new equipment and technology, as well as into the technical improvement of production and the spread in this connection of the credit form of the financing of measures on scientific and technical progress, also merits attention and serious study. Special-purpose budget allocations, the assets of the sectorial fund for the development of science and technology and of enterprises and associations, which are concentrated in development funds, could be used as the assets for the authorized capital of such a bank. There would be included in the tasks of the bank:

--the concentration of assets and the special-purpose financing of expenditures on the implementation of various kinds of scientific and technical programs, including with the granting of privileges and the crediting of interest for keeping on deposit the temporarily idle assets of sectors, associations and enterprises, which are used for extending credit and so forth;

--the appraisal of the effectiveness of the measures being financed, the organization of competitive research and development;

--the flexible redistribution of monetary resources among the stages of the innovation cycle for the purpose of eliminating "bottlenecks";

--active participation in the development of cost accounting relations among the participants in the innovation cycle;

--the extension of long-term and short-term credit for expenditures on the stages of the innovation process;

--other functions which are characteristic of a bank of this sort.

At present other points of view with respect to the questions of the financing of operations on the stages of the innovation cycle also exist. One of them, which is expressed quite often, is based on the fact that there should correspond to each stage and even phase of the operations its own source of assets, which is formed with allowance made for the specific economic nature of the processes characteristic of them, the uncertainty, the risk, the difference in time of the expenditures and the results. In our opinion, such an approach will hardly promote the transformation of the innovation process into a unified object of planning and financing.

In the area of the economic stimulation of the participants in the innovation cycle their interest and responsibility for the timely and high quality achievement of the planned end results should be increased. It is possible to accomplish this task by the development of cost accounting relations. At present the interest of production associations and enterprises in the assimilation and introduction of innovations is inadequate due to the imperfection of the prevailing indicators of the planning and evaluation of their work, as well as the small amount of the incentives for the development and introduction of new equipment in the total amount of bonus payments.

The task of improving the stimulation of scientific and technical progress consists in shifting the center of gravity from volumetric quantitative characteristics to the evaluation of the integral economic impact for the national economy from the production and use of new equipment (technology). At present only a portion of this impact--the decrease of the production cost, and without a connection with the dynamics of the capital intensiveness and capital-output ratio of production--to a certain extent is taken into account when planning.

The volume of production of new equipment, in our opinion, should become an important indicator of the state plan. This will avert the possibility of the fulfillment of the plan assignments on the output of products by means of their obsolete inefficient types. One should also change over to the evaluation of the activity of associations and enterprises according to the physical, conditional physical and volumetric indicators of the scientific and technical level and efficiency, which ensures their maximum interest in the saving of resources, in the technical improvement of production and in the increase of the quality of the products being produced.

The technical and economic level of production, which is expressed integrally or through the set of characteristics of the technological processes being used and the product quality, could become one of these indicators. As is known, in accordance with the decree of the CPSU Central Committee and the USSR Council of Ministers of 12 July 1979, "On Improving Planning and

Strengthening the Influence of the Economic Mechanism on Increasing Production Efficiency and Work Quality," the technical level and product quality are already included among the planned and evaluation indicators of the activity of ministries, associations and enterprises. However, in recent times the role of these indicators has decreased somewhat.

For the introduction of the technical and economic level of production in planning practice it is necessary along with the products to certify the technological processes being used in production. Such an approach is already being used in the USSR Ministry of the Electrical Equipment Industry and a number of other departments.

Now it is also especially important that the planning of industrial production would be carried out comprehensively, in close interconnection with the increase of its technical (technological) level, which ensures the successful assimilation and introduction of the latest achievements of science and technology. In the sectorial scientific and technical programs it is necessary to stipulate by calendar periods specific limits of the achievement of the technical and economic level of products and the technical level of production (technology, fixed production capital and its active part), which corresponds to them. In turn, the operations on the technical development of the most important sectors of production, for example, ferrous metallurgy, agricultural machine building and so on, should be included in the intersectorial scientific and technical programs.

Since at present the intensification of the development of the economy, first of all, is proceeding in the direction of the renovation and retooling of the production apparatus, it is necessary to elaborate and approve prior to the start of the formulation of the next five-year plan the assignments for their accomplishment by enterprises and sectors in conformity with special long-term concepts of technical improvement.

The task of increasing the economic stimulation of the participants in the innovation process presumes the development of cost accounting relations with regard to the distribution and redistribution of the additional profit which is obtained from the development, assimilation and introduction of new equipment (technology).

There has formed in our country the practice, when this profit, which is the result of the activity of many organizations and enterprises of different sectors of the national economy, which are participating in the innovation process, serves as a source of the economic stimulation first of all of the main developers and producers of the new final product. Such a situation places in a disadvantageous position the organizations and enterprises of the sectors which develop and produce for it components and new materials of a higher quality. The large-tonnage chemical industry, which produces plasticizers, preservatives, catalysts and other important components for industrial production, which substantially improve the properties of the final product in many sectors of production, can serve as an example. The introduction of new plasticizers increases the wear resistance of tires for motor vehicles by 1.5- to 2-fold, which leads to a saving of hundreds of millions of rubles, not to mention the decrease of the consumption of scarce

raw materials and power. However, given the existing pricing system the enterprises of the USSR Ministry of the Chemical Industry do not have the proper interest in the production of the needed assortment and the necessary amounts of these components owing to the fact that, as a rule, the increase of the prices for them subject to the increase of the economic effectiveness for the national economy of the final product is not envisaged.

In order to solve this problem, there should be established for the sectors, which are participating in the production of a final product of a high technical level and quality, fixed markups on the prices for highly efficient components and materials, which are supplied for its production, on the basis of the additional profit which is obtained by the national economy from the use of the results of the completed development. The standards of such wholesale price markups should be established by planning organs with allowance made for the amount of the additional profit, and with the use of an effectively stimulating mechanism of its distribution. Here it should not be overlooked that its corresponding part should left with the user of the final product and should be channeled into the state budget. The increase of the economic interest of the sectors which supply machine building, the technical level and quality of whose final product in many respects is determined by the level and quality of the materials and components being supplied to it, is especially important. Now, for example, ferrous and nonferrous metallurgy, which produce the structural materials needed by machine building, are poorly interested economically in the updating of the range and the increase of the quality of their products, since this requires additional, as a rule, uncompensated expenditures.

Thus, the flexibility of the prevailing economic mechanism is a guarantee of success in the realization of the innovation cycle. The increased economic interest of the participants in innovation processes in the development, introduction and efficient use of new equipment and technology is capable of improving the situation. In addition to the stimulating distribution and redistribution of the additional profit from their use the assurance of the flexibility of the economic mechanism when solving the problems of the technical improvement of production requires today the creation at all levels of reserves for the success progress of innovation processes and the granting to ministries and departments, associations and enterprises of the right of the unobstructed receipt and transfer to each other of all types of resources, which are necessary for the development, assimilation and introduction of new equipment and technology. The changeover to wholesale trade in material and technical resources will make it possible to increase significantly the interest of the participants in innovation processes in their timely development and introduction and will eliminate one of the main obstacles in the way of the acceleration of scientific and technical progress.

The innovation process is like a stream--it can be laminar and turbulent, on some sections its speed increases, on others it slows down. Slowing takes place, as a rule, at the junctions between the stages of the "research--production--use" cycle. This, first of all, is the stage of the pilot experimental checking of new equipment. The lack of capacities of pilot production is one of the main causes of irregularities in the innovation process. Not by chance, therefore, was special attention devoted in the

decree of the CPSU Central Committee and the USSR Council of Ministers of 18 August 1983 "On Measures on the Acceleration of Scientific and Technical Progress in the National Economy" to the question of the development and strengthening of pilot experimental bases.

The stage of the assimilation of new equipment and the introduction of technical innovations in production should be regarded as another weak link in the innovation process. The establishment in the country of a network of sectorial and intersectorial cost accounting centers of introduction, which specialize in specific types of equipment, technological processes, automated control systems and so on, might be one of the means of solving this problem. Having been provided with specific assets and resources (at the expense of the state or shares of ministries and departments), the indicated centers could in accordance with orders, which are paid for by production associations and enterprises, engage in the development and introduction of new equipment and technology. Here they, as equal participants in the innovation process, would use a portion of the additional profit, which was obtained from introduction, for supplementing the reserve of working capital and forming economic stimulation funds.

The problem of supplying scientific and planning and design organizations with scientific instruments, stands, devices and equipment requires its solution, But in many cases it is inadvisable to have at each institute all types of instruments and equipment, especially single-design ones, which are not used constantly. Therefore it seems necessary for the increase of the performed scientific research, planning and design and experimental operations to create for groups of similar sectors cost accounting centers for the rental of scientific equipment, instruments, test standards and devices. These centers should bear full responsibility for the quality of instruments and their conformity to the latest achievements of domestic and foreign instrument making. It would be possible to allocate to the equipment rental center a specific amount of currency assets for the purpose of purchasing abroad instruments and scientific equipment, which are not produced in our country. It is most convenient to open such centers on the basis of proportionate contributions of the users. Some experience of organizing the indicated centers has not yet found extensive dissemination due to the lack of standard documents which specify their status and the system of economic relations with the users.

The further improvement of the structure of the organizations and subdivisions of enterprises, which are concerned with the solution of technological problems, is required for the acceleration of the development and introduction in production of advanced technological processes and materials. The creation of powerful intersectorial and sectorial technological centers, which increase the technical and technological level of production in the sectors of the national economy and promote the acceleration of the assimilation of the latest technologies, might be one of the directions of such improvement. This would make it possible to centralize the supervision of the assimilation of new technology in the national economy and to use most completely the scientific, design and experimental production potential of the country. The introduction at operating enterprises and enterprises, which are being newly built and renovated, of advanced technological processes, highly productive

equipment and automated systems for the control of technological process and means of the mechanization and automation of production processes should become the main task of such centers.

The most important, not completely solved problem of the acceleration of the assimilation and introduction of new equipment is the offsetting of the worsening of the basic technical and economic indicators of the activity of associations and enterprises during the period of the assimilation of the series production of new production and the introduction of new items into use. This is connected with the fact that the corresponding expenditures frequently exceed significantly the possibilities of enterprises to cover them. Suggestions, which merit attention, on the formulation and strict use of scientifically sound standards, which regulate the amounts of outlays on the assimilation of new equipment and its time, are being expressed.

The production development fund, which is presently being created at industrial enterprises, is playing an important role in the acceleration of innovation processes, the increase of the efficiency of reproduction and the use of fixed capital and the consolidation of cost accounting. Its formation, starting in 1965, has enabled them to establish the necessary financial base for renovation and retooling. However, with the passage of time the initial purpose of the indicated fund began to be lost. At first the limiting of noncentralized capital investments was introduced, as a result of which the portion of the assets of the development fund, which exceeded the limit, began to be withdrawn for the state budget. Then, when in 1977 they abandoned the division of capital investments when planning into centralized and noncentralized capital investments and the preferential channeling of the assets of the production development fund into new construction and renovation began, the economic operational independence of production associations and enterprises in the use of this fund decreased significantly. In essence its transformation into a source of the financing of centralized capital investments occurred. Such a measure, it is true, was motivated by the requirements of the more complete backing of expenditures from the development fund with material and technical resources. In practice, however, the interest and possibilities in the renovation and retooling of production decreased.

Today the need to change the procedure of the formation and use of the assets of the production development fund has become imminent. In our opinion, it is necessary to specify the main direction of these assets, namely the financing of operations on the retooling and renovation of operating associations and enterprises, which are carried out in accordance with plans and estimates, which are approved independently by them, and to see to it that the construction projects, which are envisaged in the plans, would be included in the state plan of capital investments and contracting operations for the purpose of their unconditional supply with material and technical resources. Such a procedure is already being experimented with in a number of industrial ministries.

The strengthening of the financial influence on the acceleration of the process of updating the productive capital to a significant extent is governed by the possibility of using to advantage the monetary assets which are

intended for the purposes of reproduction. First of all this concerns amortization deductions. In conformity with the prevailing statutes such deductions for renovation are distributed, for the most part, through two channels: from 10 to 50 percent is channeled into the production development fund, the remainder goes to the USSR Bank for Financing Capital Investments or the USSR State Bank for financing the expenditures on capital construction.

Such a procedure is being extended to all production associations and enterprises regardless of the "age" of the fixed capital being used by them and the actual need for financial assets for its reproduction, while envisaging the partial redistribution of the amortization deductions within the sector. Meanwhile, there are being encountered in practice instances when for some enterprises, which do work on old equipment, a tense situation with the financial resources for its replacement forms, while others, which use new machines and devices, have a surplus of these assets.

Taking this circumstance into account, it would be advisable to make certain adjustments in the prevailing procedure of the distribution and use of amortization deductions. Since the amortization fund for renovation, which is formed at enterprises which have been newly put into operation, for a number of years has been in significant part idle, the temporarily unused assets should be redistributed through the bank for the technical development of associations and enterprises with obsolete equipment. Such a method should be based on the principles of repayment. From the moment of the achievement of the average standard service life of the active portion of the fixed capital and the appearance of the need for its mass replacement the previously withdrawn amounts of amortization should be returned to the enterprise. It would be possible to pay interest for the use of the temporarily redistributed assets of enterprises.

The increase during the 11th Five-Year Plan of the rate of the updating of fixed production capital, which is envisaged in the Basic Directions of USSR Social and Economic Development for 1981-1985, requires the corresponding increase of the share of the amortization deductions, which are being channeled into the replacement of equipment, and the decrease of the expenditures on capital repair. Taking into account that during the 9th Five-Year Plan new rates of amortization had already been elaborated and put into effect, at present their regular revision is hardly advisable, since this measure involves significant expenditures of financial resources and time. Therefore, ministries (associations and enterprises) should be granted more extensive rights in the area of the change of the ratio between the portions of amortization, which are intended for renovation and capital repair within the limits of its overall rate, having made this change dependent on the actual need for assets for the complete and partial replacement of the fixed capital.

In the future, with the acceleration of the rate of the updating of fixed capital and the decrease of the need for the repair of equipment, it is advisable to examine the question of the direct assignment of the actual expenditures on capital repair immediately to the product cost. At present enterprises are not solving the problem of determining the economic effectiveness of capital repair. The existence of a stable planned source

(the amortization fund) enables them by means of the temporarily idle amortization deductions for new equipment to spend on the capital repair of old equipment considerable assets, which in their amounts frequently exceed the initial value of the productive capital. The inclusion of the expenditures on capital repair directly in the production costs will force enterprises to reject the making of ineffective expenditures on it (with the exception of single-design equipment) and will increase their interest in accelerating the replacement of fixed capital. The introduction of the proposed procedure will also eliminate the problem of the monthly crediting of amortization for capital repair for each inventorial object and will simplify the work of the accounting office at enterprises.

The use of the financial and credit mechanism for the acceleration of scientific and technical progress is not confined to the problems of the financing of the very measures on the development and introduction of the achievements of science and technology. The main thing is for this mechanism in unity with all the methods of planned management to aim the activity of enterprises at the increase of the overall efficiency of production. Meanwhile, at present the financing of and extension of credit to enterprises are inadequately linked with the extent to which they improve the end national economic results. In the distribution of the profit the so-called principle of the withdrawal of its net surplus, which involves planning from the achieved level and numerous adjustments of the financial plans, still remains. The indicated procedure in practice frees enterprises from economic responsibility for a great actual effectiveness of capital investments and new equipment.

The need to fulfill more consistently the adopted decisions on the distribution of the profit in accordance with preset standards, which are envisaged in the five-year plan, is imminent. In the future a changeover should be made to distribution, which combines the collection of a fee for capital and other initial payments to the state in the form of a profit tax.

The practical implementation of the proposed measures will make it possible to significantly speed up the innovation process in the national economy and will create the prerequisites for the acceleration of the rate of the intensification of the economy as a priority task of the increase of the efficiency of social production.

FOOTNOTE

1. Calculated according to [1].

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ORGANIZATION, PLANNING AND COORDINATION

BETTER ORGANIZATION OF RESEARCH, DEVELOPMENT, DESIGNING

Moscow IZVESTIYA in Russian 8 Apr 85 p 2

[Article by Doctor of Economic Sciences Professor K. Puzynya, prorector for scientific work of the Leningrad Institute of Engineering Economics imeni P. Togliatti: "Creativity Also Needs Technology"]

[Text] Until recently the process of scientific research and development, which even are of applied importance, was perceived by many as particularly stochastic. It was claimed that it verges on art, depends on the abilities, talent, fantasy and personal initiative of the performers and therefore, they say, poorly lends itself to any formalization and even management.

Those who are also of such an opinion today, simply have an insufficiently clear idea of the content and specific nature of research and development. And therefore they consider it impossible and even inadmissible to place them in some rigid framework. At the same time the works of a number of domestic and foreign scientists and the practice of recent years have shown that the processes of creative scientific work, which involve the development of new machines, instruments and devices, materials and technologies, for the most part consist of such actions which can be quite accurately described, modeled, organized and planned.

Many years ago Corresponding Member of the USSR Academy of Sciences (now Academician) N. Moiseyev convincingly demonstrated the need for the performance of scientific research and experimental design work in accordance with a sound technology. Back in the 1960's Doctor of Economic Sciences Professor A. Grenkov developed and introduced at a sectorial institute standard technological processes of the conducting of research and the development of new equipment.

However, to this day scientific research and designing are being carried out in our country primarily by traditional, "unorganized" methods. A typical detail: computers are being used more and more often as powerful calculators, while their potentials for the choice of alternatives, the modeling of an experiment and technical and working designing are being used very poorly.

It has become the rule that the researcher, the designer and the planner work according to some "unwritten" technology--their own or one recommended by the

manager, one borrowed from senior associates or from experienced specialists. He carries it out, directing attention to his own experience and to the fragmentary information on the experience of other scientific research institutes and design bureaus, which he is able to get hold of.

This is explained first of all by the fact that at higher educational institutions future specialists actually do not acquire the necessary knowledge about how to use more efficiently individual types of works and operations during research and designing, what computational methods, modeling devices and other means of mechanization to use here, what advanced means of designing to use when developing new models of equipment. Is it not for that reason that so often scientists and designers do not know how to properly pose a problem, to outline a plan of research and experiments and to make an information and patent search?

In many cases research is conducted by the trial and error method, which requires a large exhaustive search for different versions and long periods of scientific research development and experimental design work. But back in the 1920's well-known economist P. Popov reasonably asserted that it is necessary to teach the scientist and designer "a creative trade," just as they teach an actor stage skills.

Creative ideas rarely originate all at once, suddenly. They appear when a certain amount of knowledge has been accumulated, the need for the solution of some new problem has been realized, a lot of information has been studied. The use in the process of searching for technical solutions of the method of analogy with natural and imaginary objects, as well as of a certain method, in case of which the designer as if put himself in the place of a machine or does everything the opposite way, provides extensive possibilities for the identification of new ideas, which at first look strange, but on examination prove to be brilliant design discoveries.

The method of the organization of thinking on the basis of morphological analysis, which has been forgotten by many, is very productive. Its point is that they make into a special table the information on the most important technical characteristics of the object being analyzed (previously known or theoretically possible characteristics). The various combinations of these characteristics give a wide choice of ideas or versions of the solution of a problem, which given a different--the traditional--approach often simply escape the attention of engineers. In spite of its recognized reputation, this method never received universal recognition at scientific research institutes and design bureaus. And it is a pity. We have more than once been convinced of its merits on the basis of our own experience. Thus, precisely by means of this method, which was design for a computer, a group of students of our institute found a successful design solution of an important assembly of a pneumatic transporter for bulk materials. This development was recognized as an invention, as also were, incidentally, three other innovations suggested by students.

The "brainstorming" method, which serves as an excellent means of generating ideas, is more popular in our times. I will cite just one example. The specialists, who are increasing their skills at our institute in the special

faculty of organizers of the management of scientific research, have conducted tens of such "storms." And all of them proved to be successful. In particular, the developers of the All-Union Scientific Research Institute of Technical Esthetics in a short time developed an improved design of a new streetcar, while for the Leningrad Optical Mechanical Association it was possible to solve a problem connected with the thermal deformations of a spectrophotometer.

Modern machines, instruments and apparatus consist of thousands, and at times tens of thousands of parts which are united into assemblies and modules. The principle of modular designing makes it possible to speed up the process of developing all this new equipment. It makes it possible to develop simultaneously, regardless of each other the functionally complete and structurally arranged modules, from which, like from children's blocks, devices, machines and systems of machines, which are distinguished by their own functions and purpose, are assembled.

Owing to this new types of radio equipment and systems of automatic machines are developed two- to threefold faster and with significantly fewer expenditures of assets.

The use of value engineering, which makes it possible to determine the efficient composition of the functions and modules of the design and to check possible technical solutions from the standpoint of the efficiency of production and use, yields a high economic impact in case of such a method of designing. Thus, for example, the analysis of the functional structure of the automated power plant of a transport ship, which was made by specialists before the start of designing, helped them to find a new, more compact design and to decrease the number of modules being developed. As a result the time of the development of the plant was cut in half, its cost was reduced drastically. Here the quality of the machine did not worsen in the least, its reliability increased.

The main peculiarity of such an analysis is the comprehensive approach to the identification of unnecessary or excessive functions of new equipment. It leads to a decrease of expenditures at all the stages of design work. Its use in case of the development of electrical engineering items, optical mechanical instruments, radio equipment and electronic devices, machine tools and power-generating units has already turned for the national economy into a saving of many millions of rubles. Here is a typical example. The specialists of one of the enterprises of Zaporozhye, having used when developing control autotransformers value engineering and a number of other advanced technological methods of designing, were able to increase the service life of their items by sixfold, moreover, the production cost of the items was reduced by 20 percent. The economic impact from the output and use of such items came to more than 5.5 million rubles a year.

Several years ago at the All-Union Conference on the Scientific Organization of Labor at Scientific Research Institutes, Design Bureaus and Planning Institutes there was a serious discussion on the intensification of scientific and engineering labor. The appropriate recommendations were drawn up, the question of the need for the thorough study and introduction of an efficient

technology of research and experimental design development was posed to ministries and departments.

But nearly everything, which was spoken about at that time, remained on paper. But vast assets are being invested in the development of automated systems of scientific research (ASNI's), systems of computer-aided design (SAPR's) and automated workplaces (ARM's).

Of course, all these are important and necessary measures. But we should not forget a very significant circumstance: the extensive introduction of means of the automation of scientific and engineering operations requires substantial technological and organizational preparation. Without a regulated technology of the performance of research and development and without the construction of the entire chain of the development of new ideas it is possible to discredit the very idea of the automation of creative processes. We already have bitter experience of this sort--the introduction of automated production control systems without the proper analysis and improvement of the technology of control. Precisely for this reason many automated production control systems did not become control systems. As a rule, they were able to perform only the functions of an automated data bank, that is, a simple information storage.

Repetition of such expensive mistakes must not be allowed in the future. Today it is especially important to provide the technological basis of the automation of scientific research and designing and planning operations. Only on this condition will the sharp acceleration of the pace of scientific and technical progress and the real intensification of the processes of research, development and designing become possible.

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ORGANIZATION, PLANNING AND COORDINATION

UKRAINIAN VUZ'S ENLISTED TO SET UP NEW RESEARCH PROGRAMS

Moscow EKONOMICHESKIYE NAUKI in Russian No 4, Apr 85 pp 125-126

[Article by Professor I. Stupnitskiy, dean of the economics department of Kiev University and doctor of economic sciences]

[Text] In carrying out the decisions of the 26th CPSU Congress, the political-economic scientists of Ukrainian SSR VUZ's have concentrated efforts on investigating economic regularities of developed socialist society, of ways to increase the effectiveness of socialist production, of improvement in the economic mechanism, of improvement in the exploitation of economic potential, and of acceleration of scientific and technical progress.

Complex inter-VUZ scientific-research programs have become a qualitatively new form of organization and planning for political-economic research in VUZ's of the republic. This form of organization and planning of scientific research in the field of social sciences was introduced for the first time by the UkSSR Ministry of Higher and Secondary Specialized Education. The chief purpose of the special-purpose program method is to increase the theoretical significance of political-economic scientific developments, to strengthen their relationships with economic practice, to direct research toward the achievement of end results, and toward better training of highly qualified economists for the Soviet Union, for other countries of the socialist concord, and for developing states.

In accord with orders from the UkSSR Ministry of Higher and Secondary Specialized Education, six complex inter-VUZ scientific-research programs have been formulated: "Economic Laws and the Economic Mechanism for Developed Socialist Society" (leader: A. A. Chukhno, corresponding-member of the UkSSR Academy of Sciences); "Economic Laws and Research on the Economic Potential of Developed Socialism" (leader: I. S. Stupnitskiy, doctor of economic sciences); "Scientific and Technical Progress and the Development of the Primarily Intensive Type of Socialist Reproduction on an Expanded Scale" (leader: M. S. Chernenko, doctor of economic sciences); "Critique of Contemporary Anti-Marxist Economic Concepts Under Conditions of Competition Between Two World Systems" (leader: R. Kh. Vasilyeva, doctor of economic sciences); "Social-Economic Regularities in the Development of a World Socialist System" (leader: V. S. Budkin, doctor of economic sciences); and "State-Monopolistic Capitalism as a Social-Economic System:

Deepening Contradictions and Antagonisms" (leader: S. V. Mochernyy, doctor of economic sciences).

Responsibility for fulfilling four republic programs has been entrusted to the economic faculty of Kiev University as the head organization. This was because substantial research results on timely subjects have been achieved at departments of the political-economic faculty and there is experience accumulated over many years in coordinating scientific work. The faculty conducts training of political economists for VUZ's, organizes inter-VUZ scientific conferences, and accomplishes the publication of collective monographs and interagency collections of articles.

In developing the program, we assume that they should help:

--to provide maximum concentration of the scientific forces of republic political economists on the solution of really timely problems that have paramount theoretical and practical significance;

--to eliminate parallelism and duplication in scientific-research subject matter;

--to determine clearly the place and responsibility for the accomplishment of specific scientific task;

--to orient work toward the formulation of specific recommendations for planning, economic, soviet, and party organizations and toward the introduction of achieved results into the academic process;

--to improve the organization and control of the training of highly qualified personnel, above all, doctors of science;

--to provide methodological, methodical, and organizational aid to the republic VUZ political economists in scientific research;

--to promote the formulation of strong creative collectives to write large monographs on the results of fulfilling the planned tasks of the program; and

--to cooperate in the exchange of scientific information among political economists who work in the republic.

In developing programs, it was also taken into consideration that their number need not be excessively large. A program must clearly determine who, what, and when in specific terms and what kind of conditions are necessary. Programs should have a strict directive character, and it should be obligatory that tasks be fulfilled. At the same time, programs must also be flexible, that is, they should reflect changing conditions and research problems. Department heads should take part in formulating the sections and tasks of the programs. During the course of program fulfillment, existing scientific schools should be developed and new ones created.

Program management is accomplished by Coordination Councils--organizations of the section on political economy of the Scientific-Technical Council of the UkSSR and USSR Ministries of Higher and Secondary Specialized Education. These councils study the status of the research being conducted under the programs and define the prospects for their further development in UkSSR VUZ's; they designate the organizations that head the research and specific performers, and they monitor the results of their work and hear reports by topic leaders; they determine the subject matter of joint research together with the USSR and UkSSR Academies of Sciences, ministries, and agencies; they accomplish expertise as to the theoretical level and practical value of conclusions and recommendations for directive organizations, ministries, and agencies; they examine manuscripts of monographs to recommend them for printing; and they systematically conduct discussions of scientific problems at meetings of working groups of performers.

To fulfill the programs, 51 doctors of science and 147 candidates of sciences, working at 42 departments of republic VUZ's, have been enlisted.

The results of work in accordance with the programs have confirmed the high degree of effectiveness and the advantages of the new form for organizing and planning research on political economy. In accordance with the planned tasks of the program during 3 years of the 11th Five-Year Plan, 46 monograph papers have been published and 16 doctors' dissertations and 114 candidates' dissertations have been defended.

The results of fulfilling the tasks of the programs have been reflected in the nine issues of the republic interagency scientific collection VOPROSY POLITICHESKOY EKONOMII (90 printer's sheets). The overall volume of publication is 717.7 printer's sheets. The economic effect of completed contract work has exceeded 1 million rubles. It is important that teachers have received the opportunity to realize their scientific interests within the framework of common problems and to unite graduate and undergraduate students more closely under their scientific leadership.

In the process of fulfilling programs, the orientation of political-economic research has been strengthened relative to the requirements of economic practice and scientific relations have been strengthened significantly with the Institutes of Economics of the USSR and UkSSR Academies of Sciences and the Economic Scientific Research Institute of the UkSSR Gosplan. Reports on the main problems of economic theory and practice have been produced for USSR Gosplan and UkSSR Gosplan and the Institutes of Economics of the USSR and UkSSR Academies of Sciences, for the Institute of Social and Economic Problems of Foreign Countries of the UkSSR Academy of Sciences, for ministries and agencies, enterprises, and associations, and for party, soviet, and economic organizations. An agreement has been concluded by the faculty of Kiev State University for creative cooperation with the Economic Scientific Research Institute of the UkSSR Gosplan which provides for joint participation by scientists in developing the planned tasks of the programs and the preparation of specific recommendations for UkSSR Gosplan. New special courses have been introduced into the academic process. The new form of organizing and planning scientific research has contributed to increasingly active student scientific research work.

A new impulse for improving complex inter-VUZ scientific-research programs was given at the June 1984 meetings of the sections on "Political Economy" and "Economics" of the Scientific-Technical Council of the UkSSR Ministry of Higher and Secondary Specialized Education. In developing programs for the 12th Five-Year Plan, special attention was given to joint research by political economists and specialists on specific economies, to the strengthening of relationships between the programs and the Complex Program of Scientific-Technical Progress and Its Social Consequences for the Twenty-Year Period, and to more active participation by republic political economists in the preparation of economic experiments.

We are striving toward the goal that the special-purpose program method provide for creative understanding of the new phenomena of economic life on the basis of unbreakable faith in the teachings of Marxism-Leninism. The growing effectiveness of bringing about inter-VUZ complex programs will contribute to increased activity in political-economic research.

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BUDGET AND FINANCE

MATERIAL STIMULI OF SCIENTIFIC, TECHNICAL PROGRESS

Moscow SOTSIALISTICHESKIY TRUD in Russian No 3, Mar 85 pp 16-23

[Article by Candidate of Economic Sciences M. Rubenshteyn: "Material Stimulation in the Sphere of Scientific and Technical Progress"]

[Text] Under the conditions of mature socialism scientific and technical progress is the main factor of the intensification and the increase of the efficiency of production and the socioeconomic development of society. In our country approximately three-fourths of the national income and the increase of the productivity of national labor are provided by means of this factor.

An important role in the system of the management of scientific and technical progress belongs to material stimulation. But meanwhile this problem has still been inadequately studied from the standpoint of a systems approach. Different opinions and judgments on its many problems are encountered. The question of the place, role and forms of the material stimulation of scientific and technical progress in production relations and in the management of the national economy remains debatable.

Taking into account the complexity and many-sided nature of the problem in question, let us analyze several aspects of it. Let us attempt to answer the question: Does the wage influence the intensification of scientific, planning, design and introducing activity, and if so, how significantly?

If we take the sphere of scientific and technical progress as a whole, it is possible to answer this question immediately: unfortunately, the stimulating influence of the wage on the amount and quality of scientific and technical developments and on the time of their fulfillment and especially the implementation of the results and the introduction of innovations is obviously unsatisfactory. The fact that the expenditures on science from the state budget and other sources are constantly increasing, while the number of developed models of new types of machines, equipment, devices and instruments in recent years has even decreased, also attests to this.

Let us examine this problem in more detail.

The Remuneration of Labor in Science

Studies show that the system of the remuneration of labor in science for a long time has practically not changed. The increase of skills and the attachment of personnel to a certain extent are stimulated by the establishment of the wage with allowance made for the existence of an academic degree and the length of service. However, the salary is stable. Its amount does not depend on the effectiveness of scientific labor. But this hinders the optimum, highly efficient use of the abilities and possibilities of workers of scientific research institutes and design bureaus, that is, actually creates an antistimulus of scientific progress. The inflexibility in the remuneration of scientific associates does not harmonize with the complexity of their creative activity. Therefore it is necessary, in our opinion, to create regularly a portion of the income, which depends on the nature of the job being performed, as a source of individual stimulation.

The conducted certification of scientists is called upon to solve the problems of stimulation in accordance with the achieved results. However, the lack of clear criteria of the evaluation of their creative activity reduces the effectiveness of certification. Moreover, certification is often not connected either with the material incentive or with the material liability of workers. The specification of the planned amount of the wage fund and the assets for the maintenance of scientific organizations without regard for the efficiency of the activity of their collectives substantially reduces the role of the wage in the drive for the obtaining of higher and higher results with relatively decreasing expenditures.

In this connection it is legitimate to raise the issue that in science, just as in physical production, the amount and dynamics of the wage would actually depend on the quantity and quality of the socially useful labor of the individual worker and the activity of the collective as a whole. It is necessary to increase the range of the remuneration of labor within a single position, having granted the managers of scientific organizations the right on the basis of the recommendations of certification commissions to decrease and increase salaries within the salary schedule and the total wage fund. The positive results of the experiments, which have been conducted in this direction, including at the Scientific Research Physical Chemistry Institute imeni L. Ya. Karpov and more than 50 other institutes,[1] are reassuring. However, the need for the optimum solution of the problem requires further research and experiments.

The salary, in our opinion, should gradually be transformed into a dynamic quantity, which includes a guaranteed minimum and an increment which depends on the specific results of the labor of the workers. In particular, the practice of granting the managers of scientific organizations the right to increase the salaries of associates with an academic degree by 10-20 percent, if the efficiency of their labor is greater than the average efficiency for the corresponding skills group, has justified itself. For here the wage of better workers is increased without the assignment to them of administrative funds, the increase of creative activeness at each workplace is stimulated.

The need has arisen to gradually restore the preeminence of science in the remuneration of labor, as was the case 20-25 years ago. This step will make it possible to decrease the turnover of scientists and will increase the influx into science of the most talented young people. But since the allocation of additional assets for the implementation of this proposal is unlikely, another means, which is now being checked experimentally in Leningrad, remains. The decrease of the number of those employed in this sphere makes it possible to increase their wage in case of the invariability of the amount of its present fund. Moreover, the riddance of those who work unproductively will not be a loss for science.

It is also advisable, in our opinion, to note the increase of the amounts of salaries for the existence of an academic degree and an academic title, having retained their importance in case of the filling of the highest scientific and scientific teaching positions, promotion and so on. Among the weighty arguments in favor of this proposal is the fact that the orientation of the remuneration of labor mainly toward the increase of the personal skill of workers, which is signified by the obtaining of an academic degree or academic title, is not always combined with an increase of the actual scientific and technical output. Therefore, many authors believe, it is necessary to increase the share of bonuses in the total wage of scientists and engineering and technical personnel for the end results. The increments for an academic degree and academic titles do not depend on the level of the intensity and productivity of the labor of workers. Moreover, a unjustifiably large gap appears in the salaries of the workers, who have or do not have an academic degree or title. The remuneration for an academic degree frequently becomes a life annuity. At times a person receives a wage increment, even while having been a useless scientist or a mediocre instructor. Meanwhile, the amounts of the wage of scientists and science teachers should depend on the importance of the performed work.

A common category for the entire country of the remuneration of labor within the established number and wage fund should be introduced, for, in our opinion, the division, which was adopted several decades ago, of scientific institutions into three categories according to the remuneration of labor subject to the "size" of the organization and the importance of the work has become obsolete. In reality the effectiveness of the scientific activity of "small" organizations is frequently greater than that of "large" ones.

We support the opinion of those who consider it necessary to broaden the range of positions of scientific and technical personnel according to the level of the remuneration of labor (from two to four-six gradations). The results of the experiment, which has been conducted for a number of years at the Institute of World Economics and International Relations, as well as at several other scientific research institutes, in particular, serves as a weighty argument in favor of the extensive implementation of this suggestion. It has contributed to the increase of the efficiency of the labor of scientists and to the increase of their creative activity.

The Stimuli of the Labor of Engineering and Technical Personnel

The unity of the interests of scientists, designers and planners and the strength of the ties between basic and applied science, on the one hand, and pilot, series and mass production, on the other, are having a substantial influence on scientific and technical progress.

Since the labor of engineering and technical personnel should be creative, it is advisable to enlist them as extensively as possible in the solution of scientific problems in industry and other sectors of the national economy. This form of the training of scientists and the increase of the skills of engineering and technical personnel directly in the plant sector of science has substantial reserves. For example, at industrial enterprises of the country engineers with an academic degree make up only about 2 percent of the total number of engineering and technical personnel who perform scientific research. Many of them do not take part at all in research activity, since they do not have favorable conditions for this.

The personal contribution of designers and process engineers to the fulfillment of scientific and technical operations and programs, as a rule, is poorly connected with their wage. It seems that the interest in increasing the output of their creative labor will increase, if a closer dependence of the remuneration of the labor of this category of workers on their personal contribution to scientific and technical progress within the established wage fund is created. Here the experience of the Ulyanovka Main Special Design Bureau, at which the system of the remuneration of labor for the end results in combination with the brigade form of its organization has been used since 1980, about which SOTSIALISTICHESKIY TRUD has written more than once,[2] merits attention first of all.

The improvement of the remuneration of the labor of designers and process engineers, which is being carried out as an experiment at five Leningrad enterprises, is a further development of the experience of the people of Ulyanovka.

The large-scale economic experiment is also having a positive influence. The consistent development of its basic principles will make it possible to speed up the introduction of scientific and technical achievements in production and to increase the demands on the quality and technical level of the products being produced. The establishment of the wage fund on the basis of advanced, truly stable indicators and standards is called upon to promote this. The right granted to designers to depend scientific reports instead of dissertations also conforms to the interests of scientific and technical progress.

And all the same in the stimulation of designers there are serious shortcomings, when, for example, less is paid for the labor of the absolute majority of them than for the labor of bus drivers or the representatives of a number of other occupations. It is necessary to extol the names of talented designers, as is done in the aircraft industry. It is necessary to devote more attention to the material and moral stimulation of designers and

planners, who are at the source of scientific and technical progress, sustain it with their creative work and develop highly efficient equipment.

The stimulation of the efforts of designers and process engineers on the decrease of the weight and metal content of new equipment, the development and more and more extensive use of resource-saving and waste-free technological processes and the decrease of the power-output and materials-output ratios of production merit foremost attention. A multiple, excessive safety margin is often incorporated in assemblies and parts, for which much metal and additional unnecessary labor are spent. The designed equipment proves to be bulky and all the same they accept it for series production.

Why is such a thing not also possible, but also desirable for designers, although it is obviously at variance with national economic interests? Because an artificial "reserve," which makes it possible subsequently to decrease the product cost and the rates of consumption of raw materials and materials without significant efforts on the real increase of production efficiency, is created in this way. If designers would not incorporate a surplus of resources in new equipment, immediately after the revision of the wholesale price this equipment might prove to be "unprofitable" for the enterprises and the assignments on the decrease of its labor intensiveness and materials-output ratio would not be fulfilled. As a result the collective gets into a difficult economic position.

Many suggestions on how to avoid such a situation are being made. One of them, in our opinion, merits approval. It is a question of the need to identify the excess expenditures on the wage in the process of developing new items. By having a reference point in the form of a model of a theoretical design and instructions on the used technological processes, in each specific case it will become possible to determine the labor intensiveness of any item. The ratio of the expenditures on wages with respect to the production of the theoretical and real design will yield the corresponding standard. In much the same way it is possible to calculate the standards of the use of materials, electric power and so forth. The transition from the planning of the rates of consumption "from what has been achieved" to planning from the difference between the theoretical and real amounts of the specific types of expenditures will stimulate designers to the develop truly new highly efficient equipment and technology.

Designers and engineers, like all creators of new equipment, are not always used properly. Unfortunately, the tendency to turn a significant portion of them into clerks, collectors of necessary and unnecessary information, compilers of various documents, supply workers and performers of other duties, which do not require a higher technical education, academic degrees and titles, is being observed. At the same time people without the appropriate education hold many engineering positions. This is one of the causes of the decline in recent years of the prestige of engineering occupations. The number of specialists, who do not wish to work in engineering positions, is increasing.

The material and moral stimuli, salaries and bonus systems are still inadequately connected with the creative achievements of engineers and their

contribution to technical progress. For the purpose of creating favorable conditions for engineering and technical personnel it is necessary to overcome quickly this negative trend. How? First of all by the optimization of the ratio of the number of engineers and technicians, the improvement of the organization of their labor, the basic change of the criteria of its evaluation and the radical improvement of material and moral stimulation. The changeover to the standardized planning of the wage fund creates good opportunities for the stimulation of enterprising and highly productive engineering labor on the basis of the retooling of production.

The Provision of the Conditions for the Introduction of Innovations

At present less than a third of the registered inventions, moreover, far from always the most promising ones, are introduced in production. As a rule, they are used at one or two enterprises, which is, in particular, a consequence of the ineffectiveness of material stimulation. The main means for the radical improvement of matters in this area, as is also stressed in a number of party decisions, is the creation of such material and technical conditions, which contribute to the development and introduction of innovations, including the improvement of the stimulation of the labor of inventors and developers of new equipment, who have displayed initiative in the use of innovations at the works, especially for the first time. The implementation of a suggestion which was advanced long ago--to introduce a common source of the reward of an author for inventions regardless of the sphere of their possible use--could become, in our opinion, one of the essential measures for the fulfillment of this task. A specialized cost accounting fund, at the expense of the assets of which inventors, who have received certificates of authorship, will be rewarded, could be such a source. The organization, which is the holder of this fund, for a specific fee would make available to enterprises all the necessary documents, as well as would give them skilled technical assistance.[3]

For the acceleration of scientific and technical progress there should be envisaged in the State Plan of USSR Economic and Social Development the unified section "Scientific and Technical Progress and Capital Investments," having singled out a special subdivision on the implementation of major inventions. As a result the resource supply of scientific and technical operations and programs will improve, the connection between investment policy and scientific and technical policy will be closer. The need arose long ago to set up in the country a branched network of specialized subdivisions for the introduction of major inventions, as well as an organization, which would deal with the introduction of inventions of an intersectorial nature with a large economic impact.[4] It is necessary to include the conditions, which are connected with inventions, in the enforceable enactments, which regulate the procedure of operations on new equipment, planning, financing and stimulation. The system of the use of inventions will thereby become a subsystem of the cost accounting operations on new equipment. At present the efficiency of both new equipment and the use of inventions in the national economy is evaluated according to a common method.

In the process of carrying out important, fundamentally new scientific and technical operations it is necessary to take into account the two basic functions of the mechanism of their stimulation. First, the reimbursement of

the initial great expenditures on development, designing and assimilation. Second, the assurance of the material interest of workers in the increase of the scale of production and the increase of the quality of new items for production engineering purposes.

Academician S. Strumilin wrote in his day: "To stint the assets of their (efficiency experts and inventors--M.R.) stimulation is a most improvident policy. It is impossible to stimulate them at the expense of the current profit of enterprises, for the entire impact of such a movement is intended for a saving in the future. Thus, it is necessary to seek other sources for stimulation."[5]

The orientation of the system of stimulation toward the indicators of current production has a number of negative features. The long-term expenditures on scientific research and experimental design development, as well as the high costs of the process of introducing technical innovations worsen the indicators of profitability, decreasing accordingly the incentive of managers. Hence their interest in operations and programs with short payback periods, that is, as a rule, simpler ones, with a smaller degree of novelty. Fundamentally new equipment and technology conform to the interests of the national economy. Therefore, it is necessary to link the systems of the payment of bonuses to managers of various levels and units of the national economy more closely with the indicators of the fulfillment of scientific and technical operations (programs).

Increase the Effectiveness of the System of the Payment of Bonuses

For the purpose of improving the prevailing system of the payment of bonuses for new equipment many people propose to abolish the regressive scale of the determination of the amounts of bonuses, when with an increase of the economic impact from technical innovations the amount of the bonuses in terms of a specific amount of this impact decreases.[6] The implementation of this suggestion would make it possible to increase the interest of workers in the assimilation of major, highly efficient developments and would make the system of the material stimulation of technical progress more comprehensible. The limitation of the maximum amount of bonuses checks the initiative which is aimed at the broadening of the introduction of innovations and major developments with a large national economic impact.

The bonuses at sectorial scientific research institutes are established in proportion to the amount of the actual economic impact of the introduction of their developments. The stimulating functions of the basic wage prove here to be weakened, for it depends only on the amount of worked time. In this connection several authors propose to establish a standardized amount of the wage fund, for the possibility exists to calculate the maximum expenditures on scientific research and experimental design work. Overhead accounts for approximately half of them. By subtracting the fixed payments from the remainder of these expenditures, we will obtain the standardized amount of the wage fund. Its real amount will differ from the standardized amount with allowance made for the time factor. Hence the longer the period of development is, the smaller a wage will be paid. Then the opportunity to stimulate the shortening of the time of development appears.

Theoretically this suggestion seems valid. But only its experimental checking will show the real effectiveness of the new method of stimulation.

The improvement of the already adopted types of incentives and the introduction of new ones stimulate the acceleration of scientific and technical development. For example, since 1981 50 prizes of the USSR Council of Ministers have been awarded for the performance of complex scientific research, planning and design and technological operations on the most important directions of the development of the national economy, including 5 prizes of 30,000 to 50,000 rubles, 20 prizes of 15,000 to 20,000 rubles and 25 prizes of 3,000 to 12,000 rubles. They are paid from the centralized funds for the payment of bonuses for the development and introduction of new equipment. The maximum amount of the individual prize comes to 1,000 rubles. The people, who have been awarded these prizes, receive a certificate and the badge "Winner of the Prize of the USSR Council of Ministers." Since 1981 one-time bonuses for the development, assimilation and production of especially important highly efficient types of equipment and machines of mass, small-series and custom production, as well as for the development and assimilation of fundamentally new technological processes have been paid in all the machine building sectors.

In conformity with the terms of the large-scale experiment enterprises can independently use a portion of the assets of the unified fund for the development of science and technology (YeFRNT) for the performance on their own initiative of planning and design operations on the development of new equipment, as well as for the reimbursement of the increased expenditures during the period of its assimilation. The material interest of specialists and workers in the enlargement of the range (assortment) and the increase of the output of machines, equipment and instruments, which are delivered for export, is being increased. With the permission of the superior organization bonuses are paid to scientists, designers, process engineers, planners, engineers and other specialists, who ensure the development and output of products, which according to their qualitative indicators correspond to the best world and domestic models or are superior to them and satisfy the long-range demands of consumers, and the bonuses are paid in excess of the maximum amounts which are stipulated by the prevailing statutes.

Starting in 1985 one-time bonuses of USSR ministries and departments and the councils of ministers of the union republics in amounts of 3,000 to 40,000 rubles each were introduced for the increase of the material interest of the participants in the development and assimilation of highly efficient equipment, technology and new materials. Here it is important to stress that the bonuses to the managerial personnel of associations (enterprises) for the basic results of economic operations are reduced by not less than 25 percent in case of the nonfulfillment of the plans and assignments on new equipment, as well as in case of the output of products after the expiration of the standard period of their updating (modernization).[7] The overcoming of the list, which is in no way sound, in the direction of the one-sided use of positive (or encouraging) stimuli, in our opinion, is also a condition of the further increase of the effectiveness of the material stimulation of scientific and technical progress. The need has arisen to find the optimum ratio between them and negative (or compelling) stimuli, between material

stimulation and responsibility. This applies both to individual workers and collectives of scientific research institutions, design bureaus, enterprises and associations and to the regional, sectorial, intersectorial and national economic management staff.

It is necessary to increase substantially the personal responsibility of officials and economic managers for the fulfillment of the plans of scientific research and experimental design work and on new equipment. It is impossible to delay longer the application of resolute measures of material and moral responsibility to the collectives which are the developers, producers and users of new equipment and all new products for production engineering purposes. It is possible to increase noticeably the effectiveness of the system of stimulation, if regressive principles of the material stimulation of collectives and individual workers in case of the incomplete, untimely and low quality fulfillment of the plans of scientific and technical operations or programs through the fault of their performers and managers are applied constantly, everywhere and inevitably.

Enterprises at present in practice do not bear responsibility for the introduction of the developments of scientific research institutes, which have been turned over to them, and for the shortening of its time. At the same time the results of introduction at times do not influence the regularity of the receipt of bonuses by the associates of scientific research institutes and design bureaus. Often it also happens that their managers receive large bonuses, while the effectiveness of the operations (programs) remains low.

The fee for manpower resources, in our opinion, could become an additional stimulus of the introduction of new equipment, the acceleration of scientific and technical progress and the fulfillment of the plans by a smaller number of workers. Owing to this the expenditures of society on the training of skilled manpower will be offset. But the main thing is that the fee for manpower resources will prompt the managers of enterprises to introduce more extensively the mechanization and complete automation of production and management. The establishment of special-purpose payments to the budget in proportion to the number of workers and their qualitative composition would influence the financial status of enterprises and associations and the amounts of the stimulation funds. Here the stimulating functions of the wage will be aimed, on the one hand, at the increase of the effectiveness of the expenditures of living labor and, on the other, at the decrease of the number of employed people, that is, at the acceleration of scientific and technical progress by the replacement of living labor by embodied labor.

The suggestions examined in the article, of course, do not exhaust all the most important directions of the improvement of material stimulation in the sphere of scientific and technical progress. However, in our opinion, their implementation can promote the noticeable improvement of the stimulation of research, development and innovations and the increase of the interest of workers in the acceleration of the pace and the broadening of the scale of the progress of science, technology and production and in the increase of its socioeconomic effectiveness.

FOOTNOTES

1. N. Yakovchuk, "The Labor and Wage of a Scientist," SOTSIALISTICHESKIY TRUD, No 1, 1984.

2. See, for example, SOTSIALISTICHESKIY TRUD, No 2, 1985, p 44.

3. KOMMUNIST, No 7, 1982, p 50.

4. In particular, a number of suggestions were made by the participants in the discussion, which was conducted in the journal SOTSIALISTICHESKIY TRUD on the article of P. Volin "Cost Accounting Introducing Firms All the Same Are Needed," see No 10, 1982; Nos 3, 7 and 8, 1983; Nos 4, 5 and 6, 1984.

5. VOPROSY EKONOMIKI, No 9, 1968, p 23.

6. In those very rare, almost theoretically feasible cases, when large sums of remuneration can get into the hands of one or several people, it is possible to envisage some other restrictions, perhaps, in the form of a progressive tax and so forth.

7. "The Decree of the CPSU Central Committee and the USSR Council of Ministers 'On Measures on the Acceleration of Scientific and Technical Progress in the National Economy'," PRAVDA, 28 August 1983.

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BUDGET AND FINANCE

ECONOMIC STIMULI OF SCIENTIFIC, TECHNICAL PROGRESS

Moscow SOTSIALISTICHESKIY TRUD in Russian No 3, Mar 85 pp 7-16

[Article by Doctor of Economic Sciences Professor Yu. Yakovets: "The Economic Mechanism of the Acceleration of Scientific and Technical Progress"; passages rendered in all capital letters printed in boldface in source]

[Text] The significant acceleration of the pace and the increase of the efficiency of scientific and technical progress are the key to the solution of the difficult problems of the changeover of the economy to the intensive means of development and the creation of a reliable material base for the steady increase of the well-being of the people and the strengthening of the defensive capability of the country, moreover, it is a question of progress, which is oriented not toward the partial improvement of traditional equipment and technology, but toward the development, rapid assimilation and mass dissemination of the achievements of the second scientific and technical revolution, which developed in the most developed countries of the world in the middle of the 1970's. Only on the basis of fundamentally new equipment is it possible to increase labor productivity, to speed up significantly the rate of economic growth, to improve working conditions substantially and to ensure a modern level of the quality and competitive ability of domestic products.

For this it is necessary to develop an effective economic mechanism of the management of the process of the development, production and use of fundamentally new equipment.

A technological revolution cannot occur automatically, by itself. In order to accomplish it, it is necessary in the historically shortest possible time to reorganize on a qualitatively new basis the spheres of the production and use of equipment, to replace obsolete tools of labor with more efficient ones, to change cooperative relations, to retrain people; to overcome the force of habit and inertia and to destroy psychological barriers. It is possible to do this, having fundamentally united the centralized planning and management of the development and assimilation of new generations of equipment with effective economic stimuli, which prompt EVERY labor collective to a bold creative search and the introduction of scientific and technical achievements with the maximum impact for society.

The PLAN holds a leading place in the set of economic stimuli of the acceleration of scientific and technical progress. It would be incorrect to group it with purely administrative methods of influencing production, while forgetting that in the socialist economy the plan indicators and standards play an enormous mobilizing and stimulating role. They are called upon to express concretely the needs and order of society and, hence, also to be the basis for the evaluation of the results of work and the material and moral stimulation of collectives and workers.

In the system of planning the questions of the acceleration of scientific and technical progress, so it seems to us, have not yet held a central place, although in recent years much has been done in this direction. The comprehensive program of scientific and technical progress with an outlook for 20 years is becoming the starting point of the unified set of plans; within the plans there are all-union, sectorial, republic and regional scientific and technical programs; the fulfillment of the assignments on new equipment has been included among the approved and evaluation indicators. However, from the current standpoint of the day this is insufficient. Moreover, the state plan on new equipment from year to year is not fulfilled, and in the plan itself assignments on the assimilation of new equipment, and not fundamentally new equipment, which is based on major inventions, predominate. The multiplicity of scientific and technical programs is complicating their management; they are not always adequately supplied with resources. Although the number of measures on new equipment, which have been introduced in industry, is increasing from year to year, the expenditures on introduction are increasing and the return from these investments is decreasing relatively: during the period from 1970 to 1983 the additional profit per ruble of expenditures decreased from 39.3 to 33.6 kopecks, while the number of relatively freed workers per million rubles of expenditures decreased from 80 to 42 (see the table). This attests to the decreasing effectiveness of technical progress and to the orientation of the plan on new equipment toward the partial improvement of traditional generations of machines, which does not yield a large impact.

It is important to reorient the plan at all levels--from the national economy to production and scientific production associations, enterprises, scientific research institutes and design bureaus--toward the preferential assimilation of fundamentally new equipment and technology, which are capable of providing a large impact in the increase of labor productivity and in the saving of all types of resources. In our opinion, a small number of scientific and technical goal programs, which reflect the structure of the new scientific and technical revolution and are guaranteed to be supplied with resources, should become the core of the plans. It is necessary to make the fulfillment of the assignments of these programs the basic plan and evaluation indicator, and the plan indicators themselves should be differentiated. For given the present broad interpretation of the concept "new equipment" qualitatively different phenomena are grouped with it: so-called pioneer equipment, which is based on the latest inventions, requires significant expenditures on assimilation, but ensures a large impact and great competitive ability of products; new models of already assimilated generations of machines, which make it possible to use them more efficiently in various spheres; modernized equipment with improved parameters; finally, partially improved models of generations of machines,

which for their most part have become obsolete (in the last case it is possible, rather, to speak of regression, since resources are diverted in fact for the consolidation of a technical lag). Indicators, which specially single out and create a "most favored status" for fundamentally new equipment, are needed.

The Effectiveness of Measures on New Equipment in Industry*

	1970	1975	1980	1983	1983 as a percent of 1970
Number of introduced measures on new equipment, thousands	423	621	773	795	188
Actual expenditures on their introduction, including expenditures of past years, billions of rubles	5.01	7.5	9.6	11.3	226
Number of relatively freed workers, thousands	399	576	555	479	120
Additional profit from introduction of measures per year, billions of rubles	1.97	2.83	3.21	3.8	193
Annual economic impact from introduction of new equipment, billions of rubles	2.61	3.83	4.78	5.1	198
Number of relatively freed workers per million rubles of expenditures on introduction of new equipment, thousands	79.6	76.7	57.2	42.4	53
Expenditures on introduction of measures on new equipment per conditionally freed worker, thousands of rubles	12.6	13.1	17.4	23.6	187
Average annual monetary wage of workers of industry, rubles	1567	1930	2226	2410	154
Additional profit per rubles of expenditures, kopecks	39.3	37.6	33.2	33.6	86

*"Narodnoye khozyaystvo SSSR v 1980 g. Statisticheskiy yezhegodnik" [The USSR National Economy in 1980. A Statistical Yearbook], Moscow, Finansy i statistika, 1981, pp 100, 364; "Narodnoye khozyaystvo SSSR v 1983 g." [The USSR National Economy in 1983], pp 100, 411.

The consistent orientation toward the end national results of the indicators and standards of the plans on science and technology is needed at all levels of management. In the area of science, for example, the end result is not the number of completed themes, but the number of inventions and prototypes of new equipment and their potential national economic impact; in the sphere of production--not the number of introduced measures on new equipment, but the time of the assimilation and the share in the total volume of output being produced of fundamentally new and improved equipment or items. It is time to abandon the gross indicators, which direct attention to the increase of the number of scientific and technical developments and the number of measures on new equipment without regard for the level of novelty and the real national economic impact of their introduction.

FINANCIAL AND CREDIT LEVERS hold an important place in the system of the stimulation of scientific and technical progress. Their role does not reduce to the backing of the measures on the development and assimilation of new equipment, which are outlined by centralized and noncentralized plans, with financial resources. By means of these levers the priorities in the development of some directions or others of science and technology are ensured, the conditions are created for the development of the initiative of labor collectives in the implementation of scientific and technical measures and the retooling of production, and the checking of the efficiency of the use of the resources, which are being allocated for this, is carried out.

The state is channeling significant financial resources into the development of science. Thus, from 1970 to 1983 the expenditures for these purpose by means of all sources increased from 11.7 billion rubles to 26 billion rubles--by 2.2-fold (including at the expense of the state budget from 6.4 billion rubles to 12.5 billion rubles--nearly twofold).[1] In 1985 it is planned to allocate for science 27.5 billion rubles--3.6 percent more than in 1984.[2] The expenditures on the introduction of measures on new equipment in industry from 1970 to 1982 increased by 2.3-fold, while their share in the gross output of industry increased from 1.36 to 1.62 percent. In 1983 alone a decrease of these expenditures from 11.7 billion rubles to 11.3 billion rubles and of their share in the gross output to 1.5 percent occurred.[3]

However, it is important not simply to increase the expenditures on the development of science and technology, but to change the formed proportions, giving preference to basic, research operations, the experimental development of new generations of equipment and their introduction. Within the expenditures on scientific research and experimental design operations one should clearly distinguish the proportions in the distribution of resources by stages (basic research, applied research, experimental design development, introduction), ensuring the leading development of basic research and the pilot experimental base.

THE UNIFIED FUND FOR THE DEVELOPMENT OF SCIENCE AND TECHNOLOGY (YeFRNT), which has been established in 28 industrial ministries and the deductions for which by means of the profit in 1983 came to 4,778,000,000 rubles,[4] is playing an increasing role in the financing of science and technology. This has created more favorable conditions for the financing on a cost accounting basis and the

economic stimulation of sectorial science. But major shortcomings are being observed in the formation and use of this fund.

First, the formation of the fund by means of the profit makes it dependent on the financial status of associations (enterprises) and the fulfillment of the plan of the profit and understates the product cost of science-intensive sectors. It is more legitimate, in our opinion, to attribute the expenditures on the reproduction of the scientific and technical potential, just as of other production resources, to the production costs than to the net income.

Second, a dominant and increasing share of the unified fund for the development of science and technology is being channeled into the financing of sectorial scientific research institutes and design bureaus and a smaller and smaller share is being channeled into the reimbursement of the costs of assimilation and the initially greater expenditures on new equipment. This leads to the overstatement of its production cost and price (especially for fundamentally new items) and weakens the interest of producers and consumers in the updating of equipment. It is worthwhile, apparently, to increase significantly the amounts of the assets which are being allocated for these purposes. This would make it possible not only to reimburse the costs of assimilation and the greater expenditures of the first period of the production of new equipment, but also to take them into account in the volume of output and to add to these expenditures the standard profit, as was envisaged by the decree of the CPSU Central Committee and the USSR Council of Ministers of 12 July 1979 on the improvement of the economic mechanism. This would serve as an additional stimulus to the acceleration of the introduction of new equipment, since in case of the assimilation of new equipment and technology, especially fundamentally new equipment and technology, the economic indicators of enterprises worsen and the deductions for incentive funds decrease.

Third, the changeover of scientific research, design, planning and design and technological organizations to the cost accounting system of the organization of work on the development, assimilation and introduction of new equipment on the basis of supply orders (contracts), while having increased the interest of scientists, designers and process engineers in shortening the time of the fulfillment and introduction of developments, also had negative consequences. The trend toward the increase of the number and the breaking up of developments was revealed, since the incentive depends on the amount of the impact, which has actually been obtained in the national economy, while it is easier to calculate this amount and to receive a bonus in case of the completion of a job with an annual horizon and a guaranteed impact. Major themes on the development of fundamentally new equipment and technology usually last several years, the degree of risk and uncertainty with respect to them is great. Therefore, the workers of the staff of ministries more rarely assign supply orders for such themes, while sectorial scientific research institutes and design bureaus reluctantly undertake them.

It is stipulated by the methods instructions on the procedure of the formation and use of the unified fund for the development of science and technology, which were approved by the USSR State Committee for Science and Technology, the USSR State Planning Committee, the USSR Ministry of Finance and the USSR

State Committee for Prices on 11 September 1979, that the ministries (departments) allocate up to 20 percent of the assets of this fund for the conducting of main, theoretical and basic research, which is connected with the development of promising technological processes, enterprises, machines and equipment of the future, as well as for the performance of enterprising work. However, the analysis of practice shows that this section of the plan is usually filled with insignificant enterprising work and the fulfillment of commissions of the ministries. Little basic research is being conducted in the sectors. The conditions of its stimulation are unfavorable (since it is difficult to calculate with respect to it the actual economic impact), which weakens the scientific reserve in the sectors and adversely affects the technical level and competitive ability of the output being produced.

The need has arisen to improve radically the procedure of the use of the sectorial funds for the development of science and technology and to decrease drastically the number of themes financed from them, having increased significantly the share which is channeled into the creation of the scientific and technical reserve. It is also important in the area of stimulation to place under more favorable conditions the collectives and workers, who engage in basic research and develop fundamentally new equipment and technology.

The role of CREDIT in the financing of measures on the introduction of new equipment and the retooling of production, in our opinion, is still negligible. This is explained first of all by the inadequate interest of production associations (enterprises) in obtaining such credits, which it is necessary to repay with interest and to spend under the control of banks, as compared with the receipt free of charge of assets through the unified fund for the development of science and technology or the state budget. Moreover, the banks are devoting little attention to this area of activity: in 1982 for the implementation of highly effective measures on the introduction of new equipment, the expansion of the production of consumer goods and others the balances of loans came to 1,324,000,000 rubles, for the retooling and renovation of operating enterprises--3.32 billion rubles, that is, only 5 percent of the long-term credits and 1 percent of the total balance of short-term and intermediate term loans.[5]

It seems very important to increase significantly the amount of lending for operations on the development and introduction of new equipment and the retooling of production: to grant them on easy terms and to repay them by means of the technical development funds of sectors and enterprises, as well as the above-plan profit. This will make it possible to increase the maneuverability of collectives in the matter of the assimilation of inventions and new types of equipment, which were unknown to them when drawing up the five-year plan. It is advisable here to use the experience of foreign socialist countries, in which special organizations for the extension of credit for measures in the area of the development of equipment and the introduction of inventions (for example, the innovation banks in Hungary) are being established.

For the production associations (enterprises), which are operating under the conditions of the large-scale economic experiment, opportunities are being created for the attraction of additional financial and credit sources for the

performance of work on the assimilation of new equipment and the technological reequipment of production. It is permitted to use a portion of the unified fund for the development of science and technology for enterprising research and the reimbursement of the costs of the assimilation of new equipment. The production development fund, a portion of the amortization deductions for capital repair and bank credits are becoming noncentralized sources of the financing of the retooling of operating enterprises. This has broadened the possibilities of labor collectives in the acceleration of the updating of equipment. However, the achievements in this area for the present are still negligible. It was not possible to implement fully the granted rights due to the lack of plans of retooling, that is, a long-range technical policy at the level of production associations (enterprises), and the poor backing of noncentralized assets with material resources and limits of contracting construction operations.

It would be advisable to form at production (scientific production) associations and large enterprises a technical development fund. Deductions from the product cost or the profit (according to differentiated standards, with allowance made for the science intensiveness of the sector and the technical level of the enterprise), as well as a portion of the additional profit, which was obtained due to the incentive markups on the prices for new highly efficient types of products could become its source. This fund should be used for the financing of the scientific research and experimental design work, which is being performed in accordance with the plans of production (scientific production) associations and enterprises (including the expenditures on the maintenance of the scientific research institutes, design bureaus and research laboratories, which belong to them), the reimbursement of expenditures and the standard profit in case of the assimilation of new equipment, the repayment of credits for new equipment and the payment of interest on them, the payment of a reward to inventors and efficiency experts and of one-time bonuses for major achievements in the area of scientific and technical progress. This would create a stable financial base for the technical development of the basic cost accounting unit. It is necessary to note that similar funds exist in many foreign socialist countries (Bulgaria, Hungary, the GDR, Poland, the CSSR).

In connection with the formation of the technical development fund at associations (enterprises) the decrease of the amount of the deductions for the unified fund for the development of science and technology to a level, which is sufficient for the financing of sectorial scientific and technical programs and other operations, which are performed by sectorial scientific research institutes and scientific production associations, as well as for the additional reimbursement of the expenditures on the assimilation and the initial higher production costs of the new equipment, which is being introduced in conformity with the sectorial plan, is possible.

For the financing of intersectorial basic research and the reimbursement of the outlays on the assimilation of fundamentally new equipment it would be advisable to have at the disposal of the USSR State Committee of Science and Technology a centralized fund of scientific and technical progress (mainly at the expense of budget allocations). From this fund it would be possible to finance all-union scientific and technical programs and to reimburse the costs

of the introduction of new generations of machines for intersectorial purposes, as well as to issue one-time bonuses to the collectives which have achieved major gains in this matter. Such funds exist in several foreign countries (for example, in Bulgaria and Hungary).

PRICES are one of the effective levers of the economic stimulation of scientific and technical progress. They are called upon, first, to offset the socially necessary expenditures on the development and production of new equipment and to provide its producers an additional profit by means of the incentive markup on the price of highly efficient items, thereby interesting scientific research institutes, design bureaus and machine building enterprises in the development, assimilation and production of new equipment. Second, to ensure a relative decrease of the cost (the decrease of the price per unit of the effective impact) for the users of new equipment (under the socially normal conditions of its use), in order to ensure an interest in its rapid introduction. Third, to make the production and use of obsolete equipment unprofitable (by the use of price discounts, their reduction and so forth).

It is important for the planning and accounting and the stimulating functions of the price to begin to have an effect as early as possible, from the first stages of the life cycle of items. At the stage of the development of new equipment two versions are used for this: the price of the applied scientific (design) development and the limit price of the new item. The former of them offsets the socially necessary expenditures on the development of a new item and takes into account its potential efficiency, prompting scientists and designers to find the most efficient solutions. The latter in its present interpretation (in conformity with the method approved by the USSR State Committee for Prices in December 1982) in essence is a plan of the future price of the new item, which reflects the projected cost of its series production and the standard profit, as well as takes into account its efficiency as compared with the equipment being replaced. The limit price is established starting with the technical assignment for the development of the future item. It serves as if as a barrier which bars the way of inefficient equipment into production.

The main purpose of the price in the economic mechanism of the acceleration of scientific and technical progress is to be a level of the relative and absolute decrease of the cost of equipment, the decrease of the production cost and the increase of product quality. In this function no other tool can replace the price. How is this tool used?

The range of the plan encompasses only a few thousand items. Thus, the State Plan of USSR Economic and Social Development for 1983 contained assignments on 3,706 types of products, including 2,500 types of items of machine building and metalworking. More than 1,000 assignments on the assimilation of new types of products and over 300 assignments on the introduction of new technologies and measures on the mechanization and automation of production were included in the plan. In all with allowance made for the plans of ministries and departments it was envisaged to assimilate about 4,000 new types of machines, equipment, instruments and materials.[6] Meanwhile, the total range of products being produced in the country comes to about

24 million types, including several million of machine building and metalworking (including tools and spare parts). Hundreds of thousands of items, including tens of thousands of types of products of machine building, the prices for which are approved by the USSR State Committee for Prices, republic and local pricing organs, ministries and departments, are updated annually.

In the making of decisions on the delivery to production of new items and the removal from production of obsolete items prices, on whose level, ratios with similar items and internal structure their profitability or unprofitability for the cost accounting collective depends, play a most important role. Strictly limited (in level and ratios), periodically decreasing prices for equipment should economically induce production and scientific production associations and enterprises to introduce new, more efficient equipment and to replace obsolete equipment in good time both in the sphere of its production and in the sphere of use.

In case of the updating of equipment the price should, on the one hand, offset the production costs and provide a standard profit and a markup for efficiency for the producer, in order to stimulate him for the reorganization of production, which is necessary for the assimilation of the new item and the replacement of the item being produced, and, on the other hand, make profitable for the user the purchase of the new item in place of the item which has been used for a long time. It is difficult to solve these contradictory problems, especially as during the period of the assimilation of new items, when the production volume is small, while the costs are significant, their production cost frequently exceeds the limit price. For the present this contradiction is being resolved to a greater extent in favor of the producer, which frequently leads to the relative increase of the cost of the new item and thereby narrows the range of its use.

It is possible to distinguish three directions of the resolution of this contradiction. The first of them consists in the assurance in practice of a relative decrease of the cost of new equipment and in the increase of the responsibility of its developer, producer and user (buyer) for the decrease of the expenditures and prices per unit of effective impact and for the decrease of the cost of the products which are produced by means of it. The second is to make unprofitable, in practice impossible, the production and use of obsolete items and thereby to increase the aspiration of economic managers to seek and assimilate new, more efficient items by means of the timely decrease of prices, the extensive use of price reductions and graduated prices and strict assignments on the decrease of the production cost. The third is the introduction in the practice of designing, planning, pricing, economic stimulation and accounting of the full national economic impact, which encompasses a number of its components, which at present are not taken into account or are considered only in past (the social, ecological, foreign economic and qualitative impacts). This decreases substantially the indicators of the efficiency of fundamentally new equipment. It is necessary to make the main thing--the decrease of the production and marketing costs, as well as prices--the leading criteria of the evaluation of the efficiency of scientific and technical progress and the results of economic operations. In

other words, to develop and introduce a socialist mechanism of the decrease of the cost of products.

As a whole the entire COST ACCOUNTING MECHANISM should be disposed to the stimulation of scientific and technical progress. At present the fulfillment of the plan on new equipment and its efficiency affect to a very small degree the evaluation of the results of the work of cost accounting collectives and the formation and use of economic stimulation funds. It is rather quite the reverse. The assimilation of new equipment, especially fundamentally new equipment, leads to the temporary worsening of the indicators, on which the formation of the stimulation funds depends. Consequently, cost accounting interests and levers work against the updating of equipment, which involves additional, inadequately compensated expenditures, the decrease for a specific period of the volume of output and special concerns, which are inevitable in case of the retooling of production. This is one of the main causes of the systematic nonfulfillment of the state plan on new equipment and the orientation toward small, partial improvements of traditional equipment instead of fundamentally new decisions.

The main means of solving this problem, in our opinion, lie, first, in the more complete compensation by means of the technical development funds of the costs of assimilation and the temporarily greater expenditures of the initial period of the production of new equipment; second, in the sharp decrease of the interest in the production of obsolete items by the decrease of the prices for them, the use of price reductions, graduated prices and so forth; third, in the increase of the interest and responsibility of the buyers, who are the users of the equipment, in the decrease of its cost and in the timely replacement of the machines, equipment and instruments which are being used (by strict assignments on the decrease of the production cost and the reduction of the price of the products being produced).

As was noted above, one should include among the economic stimulation funds of production associations (enterprises) the technical development funds, having thereby created the economic conditions for the pursuit of a long-range scientific and technical policy and the acceleration of technical progress in the primary unit of the national economy. And in the very system of the formation and planning of incentive funds it is necessary to put in first place the criteria of scientific and technical progress: the assimilation of new items, the technical level of the output being produced, the full national economic impact of scientific and technical progress. It is also important to decide how specifically to link with these indicators the amounts of the material incentive of labor collectives (up to the brigade) and to make perceptible for them the losses connected with the output and use of obsolete equipment.

Cost accounting stimuli, as is known, act most effectively when they are directly linked with personal material interest through THE WAGE AND BONUSES. Here one also has to solve a number of problems from the standpoint of the more active and substantial stimulation of scientific and technical progress. For the present the use of the material incentive fund, which has reached impressive amounts (in 1983 for industry 7.3 billion rubles, or 193 rubles a year per worker of the industrial personnel engaged directly in production

with an average monthly monetary wage of 199.4 rubles), is poorly connected with the achievements in the area of technical progress. This fund for the most part is channeled into monthly and quarterly bonuses, which are linked mainly with the output of products, the fulfillment of obligations on contracts, the saving of material resources and the payment of rewards in accordance with the results of the year. The assets for the payment of bonuses to workers for the development and introduction of new equipment come to a small amount (in 1983 366 million rubles for industry, or 9.7 rubles a year per person, that is, only 0.4 percent of the annual wage). These bonuses encompass a small group of workers and cannot have a substantial influence on the interest of the collective in the updating of equipment and cannot cover the temporary losses of incentive funds, which are connected with this.

In conformity with the decree of the CPSU Central Committee and the USSR Council of Minister of 18 August 1983 "On Measures on the Acceleration of Scientific and Technical Progress in the National Economy" in case of the nonfulfillment of the plans and assignments on the development and assimilation of new equipment and the introduction of advanced technology and advanced know-how the total amount of the bonus to the managerial personnel of production associations (enterprises) for the basic results of economic operations is reduced by not less than 25 percent. This will help to increase the economic responsibility of economic managers for the fulfillment of the plan on new equipment, but will not concern the entire broad group of workers who are involved in this.

For the increase of the material interest of the participants in the development and assimilation in production of highly efficient equipment, advanced technology and new materials (first of all for the development and assimilation in production of materials, equipment and instruments, which are included in the list of types of products of machine building, which are of the greatest national economic importance) in conformity with this decree one-time bonuses of USSR ministries and departments and the councils of ministers of the union republics (by means of the centralized bonus fund for the development, assimilation and introduction of new equipment) in the amounts of 3,000 to 40,000 rubles each were introduced starting in 1985. However, a comparatively small portion of the workers will receive these bonuses. Apparently, it is advisable to make the material incentives for achievements in the area of technical progress (just as the losses for the production and use of obsolete equipment) a mass and perceptible phenomenon, so that they would directly affect the amount of the variable portion of the wage of designers, process engineers, engineers, workers and economic managers. Precisely then the movement for the updating of equipment, in our conviction, can acquire a truly mass nature.

The formed disproportions in the remuneration of the labor of those employed in science and scientific service and of engineering and technical personnel adversely affect the pace of scientific and technical progress.

The average wage of those employed in science and scientific service has increased in 43 years by 4.1-fold, engineering and technical personnel in industry--3.2-fold, in construction--3-fold. However, as compared with the average wage for the national economy and the leading sectors the level of the

remuneration of the labor of these categories of workers has increased significantly, while in construction the wage of a worker is now greater than that of an engineer. Although objective grounds exist for decreasing the gap in the wage, since the overall level of education of those employed in the national economy has increased significantly (in 1939 of the number of those employed primarily in physical labor only 4.5 percent had not less than an incomplete secondary education, while in 1983 81.5 percent did), it is impossible to admit, however, that the formed ratios in the wage reflect real differences in the level of skills of workers. They place under relatively less favorable conditions with respect to the remuneration of labor scientists and engineers, on whom first of all the development and introduction of new equipment and technology depend. This serves, perhaps, as the main cause of the decline of the prestige of these occupations in recent years and the sharp decrease of the influx of capable young people into technical higher educational institutions and faculties, and precisely at a time when talented young people are needed for the assimilation of the greatest achievements of the new scientific and technical revolution.

Apparently, the correction of the formed disproportion in the remuneration of the labor of workers and engineers should occur both in the direction of the direct increase of their salaries and by means of the differentiated increase of the variable portion of the wage, which is directly linked with the real achievements in the area of the development of science and technology. The means of solving this problem may be different, but it is among the urgent ones in the matter of increasing the material interest in the acceleration of scientific and technical progress and the improvement of the qualitative composition of the scientific and engineering staff.

The questions of the reward for inventions with allowance made for their effectiveness also merit special attention. The procedure of paying rewards for creative technical work in contrast to paying rewards for creative artistic work is extremely complex and, in our opinion, is being poorly maintained by the state. The inventor is forced himself to seek the payment of a reward, while frequently being powerless in face of bureaucratic obstacles. In this, apparently, lies one of the causes of the decrease of the number of submitted applications for inventions from 1980 to 1983 by 13 percent and the number of decisions on the issuing of certificates of authorship by 26 percent, while during the 10th Five-Year Plan as compared with the 9th Five-Year Plan the increase came respectively to 44 and 88 percent. In order to overcome this trend, it is important to be concerned about the creation of more favorable economic conditions for the development of inventing, especially in the area of major inventions of national economic importance.

The development of new forms of mass creative technical work: the organization at enterprises, scientific research institutes and design bureaus of temporary creative collectives and brigades, seminars and circles of technical education for the discussion of new problems of science and technology, the joint solution of practical problems and the study of the technology of efficiency promotion and invention, can aid substantially the mobilization of workers for the acceleration of scientific and technical progress.

The acceleration of scientific and technical progress is a strategic task, the accomplishment of which requires the qualitative improvement of the economic mechanism, which skillfully combines the centralized planned management of the mastering of the heights of the new scientific and technical revolution and with the real interest and responsibility of all labor collectives and each worker in the updating of equipment and the increase of its efficiency.

FOOTNOTES

1. "Narodnoye khozyaystvo SSSR v 1983 g." [The USSR National Economy in 1983], pp 409, 549, 550.

2. N. K. Baybakov, "O Gosudarstvennom plane ekonomicheskogo i sotsialnogo razvitiya SSSR na 1985 god i vypolnenii plana v 1984 godu" [On the State Plan of USSR Economic and Social Development for 1984 and the Fulfillment of the Plan in 1983], Moscow, Politizdat, 1984, p 30.

3. "Narodnoye khozyaystvo SSSR v 1980 g." [The USSR National Economy in 1980], p 100; "Narodnoye khozyaystvo SSSR v 1983 g.," pp 110, 119.

4. "Narodnoye khozyaystvo SSSR v 1983 g.," p 537.

5. "Narodnoye khozyaystvo SSSR v 1982 g." [The USSR National Economy in 1982], pp 526, 528.

6. D. V. Ukrainskiy and G. Ya. Kiperman, "Planirovaniye i otsenka raboty promyshlennogo predpriyatiya. Pokazateli i effektivnost" [The Planning and Evaluation of the Work of an Industrial Enterprise. Indicators and Efficiency], Moscow, Ekonomika, 1984, p 89; N. K. Baybakov, "O Gosudarstvennom plane ekonomicheskogo i sotsialnogo razvitiya SSSR na 1983 god i vypolnenii plana v 1982 godu" [On the State Plan of USSR Economic and Social Development for 1983 and the Fulfillment of the Plan in 1982], Moscow, Politizdat, 1982, p 25.

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BUDGET AND FINANCE

STIMULATION OF COLLECTIVES FOR INTRODUCING INNOVATIONS

Moscow PRAVDA in Russian 19 Apr 85 p 2

[Article by Corresponding Member of the USSR Academy of Sciences P. Bunich: "Stimulation for the Result"]

> [Text] I read carefully in PRAVDA for 9 January the letter of inventors "The Innovation: From the Idea to Embodiment." The authors of the letter correctly note: in order to expedite the introduction of the achievements of science and technology in production, it is necessary to rely more completely than now on the interests of each participant in this process.

At present the introduction of the achievements of technical progress for many labor collectives is as if "unprofitable." If they begin to introduce innovations at the stage of the formulation of the plan, this will make the plan hard to fulfill. A high percentage of the assignments may be endangered, while the wage for basic activity will not increase. Per unit of the intensity of labor it will even decrease.

If technical innovations make their way into the world during the fulfillment of the plan, their results will enter the plan of the next period. And then they will give a new plan which is more difficult and complicate, for it is drawn up from the "base," while the same wage will be retained. Planning from the "base" is inevitable, for the present many enterprises are trying to reduce the strain of labor even as compared with the achieved strain.

The impact of scientific developments in this situation also decreases because a significant portion of the financial resources for their introduction in reality is not earned by plant collectives, but is allocated by society. The obtained assets are therefore spent with little benefit. The free nature of capital investments is one of the significant reasons for their low return.

Since the enterprises themselves, to put it mildly, do not aspire to achieve the greatest return from technical developments, the state is forced to exert external pressure on them. The range of directive assignments in the area of scientific and technical progress is broadening. Their fulfillment is taken into account in case of the overall evaluation of the labor of collectives and

is specially monitored. More and more goal programs are being formulated, a large number of special stimuli for the output and introduction of innovations are being introduced.

The economic experiment now being conducted permits the payment to the managers of enterprises of bonuses of up to three salaries a year in excess of the previously established limits for the output of equipment which conforms to the best domestic and foreign models.

But, in spite of the large number of steps, the situation with technical progress as before bewilders us. For if the lax attention to it would affect the basic income of workers, things would go significantly better than in case of the pressure of external factors. Therefore, although the external stimuli are large, they do not work. By acting together with internal interests and needs, given the reduction of bonuses according to special systems they would yield a better result.

It seems that the main thing in the acceleration of technical progress at the present stage is the strengthening of internal stimuli and the consideration of the interests of enterprises themselves. For this it is proposed to shift from the evaluation of the labor of collectives for the percentage of fulfillment of the plan to the evaluation of the truly concrete contribution of enterprises. This contribution should then be divide into the income of society, the wage funds and the profit which is allocated for expanded reproduction. In the model in question the wage is not built in according to the "base," but each time is "earned" anew as a result of the distribution of the cost, the production development funds also are not set, but are created.

In this case the opportunity to earn a larger wage fund will be afforded. What is one to do here? It is necessary, apparently, to impose a progressive tax on it. A special income tax is also possible for the regulation of individual wages. Here it is better not to establish absolute "ceilings" of the remuneration of labor. For people actively work mainly up to the limit of their incentive. Wage barriers have the result that a large reserve of time is still not being used. As a result the tightness of the balance of manpower resources increases, both workers and the state lose income.

If collectives prove to be directly and immediately interested in the maximum growth of output and the increase of its quality, this will also internally stimulate technical progress and ensure its "self-development." In turn this will make it possible to increase production more rapidly, to update it radically, to decrease the expenditures of resources of all types, to increase the remuneration of labor today and to earn investment funds--the income for tomorrow.

But the expenditures and results, as is known, do not coincide in time. At the start of the production of new equipment the expenditures are greater than the results. This disproportion is complicated by the fact that frequently an innovation is greeted with distrust. Its production cost at first is high, while you will not always "knock out" a suitable price.

It is advisable to regulate the financial "discrepancies" in case of the production of new equipment, as in case of the remuneration of labor, by means of special-purpose reserves which are created at times of a high profitability of obsolete products. In case of a shortage of such reserves it is possible to attract back loans. The sale of domestic licenses, for example, could also become a source of the coverage of the high expenditures of pioneering enterprises. They signify in reality the involvement in the initial financing of assets of the follower enterprises.

All this taken together forms a system of the balancing of the expenditures and results, which directs attention to the minimum expenditures and the maximum real income. When the increased costs are covered by subsidies, while the above-standard profit automatically goes to the budget, such balancing opens gaps for the overstatement of expenditures and the understatement of payment obligations.

Self-financing does not rule out budget financing and department financing which is equated with it. A kind of "division of labor" exists between them. In the future basic research should be developed, fundamentally new complex machines and types of energy and materials should be developed and assimilated, new territories should be committed to the economic turnover and a significant portion of the production and social infrastructure should be formed on a gratuitous, more precisely speaking, a redistributive basis.

At present in the country there are a large number of autonomous types of the awarding of bonuses for comparatively minor indicators. This twists the interests of collectives in the direction of the performance of operations which are rewarded more than are efficient; places enterprises under unequal conditions. The incentive for any ruble of efficiency should be equal.

The consideration of only the real contribution of the collective and the assignment to it of the entire responsibility for the results of production are possible when enterprises have been granted real rights to influence the plan and its fulfillment. What they have outlined themselves, they should themselves be responsible for. Here everything that must be done centrally will also be accomplished. How? Owing to centralized plan-orders. They are called upon to unite the force of authority with the interests and responsibility of collectives. On this condition the plan assignments will become profitable and practicable.

Another factor, which strengthens the planned basis, also exists. The point is that the striving for the highest result is possible only in case of the timely--planned--conclusion of contracts on cooperation with consumers, construction workers and other partners.

The system of the self-acceleration of technical progress can function effectively on the condition of the extension of its principles from the level of the management of the enterprise to all the internal links down to the workplace. Otherwise the worker will not know how much of the assets personally saved by him will go for his stimulation. That is why without the changeover to genuine internal plant cost accounting a new mechanism of the stimulation of technical progress cannot be developed. Incidentally, brigade

cost accounting is more closely connected with the model in question. The task is to join it with cost accounting in superior units.

The economic experiment is an important step in the direction of the stimulation of collectives for the actual results of production. But this trend needs further intensification.

First, the guarantee of the base wage fund, that is, of nearly all the remuneration of labor, cannot but decrease the pull of the movement toward technical progress. Moreover, the base indicators are often understated and large percentage increases from them, coming relatively easily to the laggards, without major technical and economic changes, do not attest to high end results.

Everything points to the fact that the conditions of the economic experiment in its present form are not fully conducive to the increase of the sensitivity of the wage to the changes to which technical progress can and should lead. The internal interests of labor collectives as before remain unaroused and concealed.

Second, the small internal production development funds are being combined with the enormous predominance of the former gratuitous mechanism of the financing of investments. The current development funds are several times less than the needs for the retooling of production.

In all these respects the principle described above, in which in accordance with unified standards (sectorial, group) a portion of every ruble of the net output, which creates the wage fund, and of every ruble of the profit, which creates the incentive and retooling fund, is deducted in favor of the collectives, seems more active.

The experiment, which is being conducted starting this year by the Sumy Machine Tool Building Association imeni M. V. Frunze and the VAZ Association, to a significant extent appears as such. These collectives have been changed over completely to the principles of the self-financing of not only simple, but also expanded reproduction.

7807
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TRAINING AND EDUCATION

CREATIVE WORK OF STUDENTS OF SECONDARY SPECIALIZED SCHOOLS

Ministry Order

Moscow BYULLETEN MINISTERSTVA VYSSHEGO I SREDNEGO SPETSIALNOGO OBRAZOVANIYA SSSR in Russian No 3, Mar 85 pp 31-33

[Order No 844 of the USSR Ministry of Higher and Secondary Specialized Education of 24 December 1984 "On the Further Improvement of the Creative Scientific and Technical Work of Students of Secondary Specialized Educational Institutions in Light of the Decisions of the April (1984) CPSU Central Committee Plenum"]

[Text] The USSR Ministry of Higher and Secondary Specialized Education, the tekhnikums and schools of the country, guided by the decisions of the 26th CPSU Congress, the June (1983) and April (1984) CPSU Central Committee plenums and by the Basic Directions of the Reform of the General Educational and Vocational School, are performing much work on the improvement of the training of skilled specialists with a secondary specialized education and on the extensive and effective enlistment of students in creative scientific and technical work.

Attaching great importance to the development of this direction of the activity of secondary specialized educational institutions, the Collegium of the USSR Ministry of Higher and Secondary Specialized Education on 15 November 1984 examined the state of creative scientific and technical work at the secondary specialized educational institutions of the Ukrainian SSR.

For the purpose of the further development of the work of secondary specialized educational institutions on the development of the creative scientific and technical work of students (NTTU) I order:

1. To commend the large amount of fruitful work of the Ukrainian SSR Ministry of Higher and Secondary Specialized Education on the enlistment of the students of secondary specialized educational institutions in creative scientific and technical work (the report is attached).

2. To endorse the experience of the Lvov Tekhnikum of Rural Construction in joint work with Lvov Polytechnical Institute on the performance of economic contractual operations on the basis of a contract on creative cooperation.

3. The Ukrainian SSR Ministry of Higher and Secondary Specialized Education (Comrade Parkhomenko):

3.1. To formulate and implement a set of measures on the further development of the creative scientific and technical work of students, which are aimed at the increase of the efficiency of the educational and training process, the strengthening of the ties of instruction with production, the efficient use of material resources, the acceleration of scientific and technical progress and the introduction of its results in the educational process.

3.2. To introduce more extensively elements of research and creative scientific and technical work in the educational process, in laboratory and practical classes, production practice, course and graduation projects and works.

3.3. To carry out the further development of specialty circles and subject circles, experimental design bureaus of students, having aimed their work at the strengthening of contact with production and the improvement of the material and technical base of tekhnikums.

4. The ministries of higher and secondary specialized education of the union republics, the main administrations of educational institutions, the administrations of educational institutions, the personnel administrations and the educational institutions of sectorial ministries and departments:

4.1. To disseminate the work experience of the Ukrainian SSR Ministry of Higher and Secondary Specialized Education and to outline additional steps, which ensure the further improvement and the increase of the efficiency of the work of tekhnikums and schools on the creative scientific and technical work of students with allowance made for the specific conditions of each region and the specific nature of the sector.

4.2. To complete the establishment of sectorial councils for the creative scientific and technical work of students, which perform organizational methods functions of the development of the creative work of subordinate secondary specialized educational institutions; jointly with enterprises and organizations of the sector to take steps on the material and technical supply of the creative scientific and technical work of students.

4.3. To implement systematically measures on the study, generalization and dissemination of the advanced know-how of the organization of the creative activity of students of tekhnikums and schools.

To specify in the sector the base secondary specialized educational institutions for the creative scientific and technical work of students, which would be a center of methods work, the site of the holding of annual exhibitions of the creative scientific and technical work of students and seminars of the chairmen of the councils for the creative scientific and technical work of students of tekhnikums and schools.

4.4. For the purpose of implementing the Basic Directions of the Reform of the General Educational and Vocational School to carry out more extensively

and efficiently the creative work of students during the period of production practice. In the programs of practical work it is necessary to envisage the participation of students in the efficiency and inventing activity of enterprises, which is aimed at the identification and elimination of the "bottlenecks" of production, as well as to include sections which envisage the organization and conducting of research by students on the job.

4.5. To develop and improve in every possible way one of the most massive forms of the creative scientific and technical work of students--subject circles and specialty circles, to ensure the efficient organization of their work and effective methods supervision.

4.6. To oblige the directors of subordinate secondary specialized educational institutions:

4.6.1. To ensure the introduction and implementation of comprehensive plans of the organization of the creative scientific and technical work of students of secondary specialized educational institutions for the entire period of instruction.

4.6.2. To implement measures, which are aimed at the extensive enlistment of instructors and other workers of the educational institution in the supervision of the creative work of students. When carrying out the certification of instructors and summarizing the results of the socialist competition to take into account their participation in creative scientific and technical work.

4.6.3. To ensure the development of practicable course and graduation designing, which makes it possible to enlist students in the performance of operations in accordance with the orders of production.

4.6.4. To take steps on the establishment at educational institutions of primary organizations of the All-Union Society of Inventors and Efficiency Experts and scientific and technical societies. To introduce in the organization of creative scientific and technical work forms of the activity of these societies, which are contributing to the strengthening of the connection of instruction with the production and public activity of future specialists.

4.6.5. To implement measures, which are aimed at the broadening of the experimental design work of students on the basis of economic contracts with industrial enterprises, institutions and organizations, kolkhozes and sovkhozes, to increase the practical significance of the themes being elaborated.

4.6.6. To introduce in work practice the organization of permanent exhibitions of the creative works of students. On the basis of these exhibitions to conduct competitive reviews of works, scientific methods conferences, the training of organizers and supervisors of the creative scientific and technical work of students, seminars of instructors for the study of the advanced know-how of the organization of the creative scientific and technical work of students, to hold more extensively subject contests,

competitions of occupational skill, to promote the achievements of the best students and instructors in creative scientific and technical work by means of the mass media, radio and television.

5. The councils of directors of secondary specialized educational institutions:

5.1. To practice more extensively the cooperation of tekhnikums and schools in the joint performance of experimental, design and research operations, the use of the material base of educational institutions, their educational production workshops, test fields, testing grounds and so on.

5.2. To broaden the creative patronage relations of tekhnikums with schools and vocational and technical schools by the organization of the joint creative work of students, the orientation of the activity of educational production workshops toward the development and output of products which are intended for educational purposes.

6. The Educational Methods Administration for Secondary Specialized Education (Comrade Shipunov):

6.1. To draft and submit by 1 October 1985 for the consideration of the collegium the Statute on the Experimental Design Work of Secondary Specialized Educational Institutions in place of the temporarily existing one.

6.2. To draft by 1 October 1986 the Statute on the Creative Scientific and Technical Work of Students of Secondary Specialized Educational Institutions.

6.3. Jointly with the Scientific Methods Office for Secondary Specialized Education (Comrade Goloviznin) to consider by 1 June 1985 the question of introducing in the curricula of secondary specialized educational institutions the course "The Principles of Creative Technical Work, Inventing and Efficiency Work."

6.4. To formulate by 1 March 1985 proposals on the introduction in the faculties for the increase of the skills of instructors of a course on the organization of the creative scientific and technical work of students of secondary specialized educational institutions.

6.5 Jointly with the Scientific and Technical Council (Comrade Krutov) to formulate and during the first quarter of 1985 to submit for approval a proposal on the organization of the All-Union Competition for the Best Experimental Design, Research and Creative Work of Students of Secondary Specialized Educational Institutions.

7. The Scientific Methods Office for Secondary Specialized Education (Comrade Goloviznin):

7.1. To continue the study and generalization of the experience of the work of secondary specialized educational institutions on the creative scientific and technical work of students, to formulate procedural recommendations on various forms of the creative scientific and technical work of students.

7.2. To elaborate by 1 December 1984 the program of the course "The Organization of the Creative Scientific and Technical Work of Students of Secondary Specialized Educational Institutions" for faculties for the increase of the skills of instructors.

8. The State Inspectorate of Secondary Specialized Educational Institutions (Comrade Pedenko) to organize the effective monitoring of the introduction of comprehensive plans of the organization of the creative scientific and technical work of students for the entire period of instruction and the state of the creative scientific and technical work of students at secondary specialized educational institutions.

9. The journal SREDNEYE SPETSIALNOYE OBRAZOVANIYE (Comrade Timonin):

9.1. To publish materials on the experience of the work on the creative scientific and technical work of students of secondary specialized educational institutions of the Ukrainian SSR.

9.2. To continue the systematic publication of materials which tell about the positive experience of the organization of creative scientific and technical work.

10. To recommend to the journal SOVREMENNAYA VYSSHAYA SHKOLA to publish materials on the experience of the work of the Ukrainian SSR Ministry of Higher and Secondary Specialized Education on the organization of the creative scientific and technical work of students of secondary specialized educational institutions.

11. To assign the monitoring of the execution of this order to the Educational Methods Administration for Secondary Specialized Education (Comrade Shipunov).

[Signed] USSR Minister of Higher and Secondary Specialized Education V. Yelyutin

Report on Ukraine

Moscow BYULLETEN MINISTERSTVA VYSSHEGO I SREDNEGO SPETSIALNOGO OBRAZOVANIYA SSSR in Russian No 3, Mar 85 pp 33-35

[Appendix to Order No 844 of the USSR Ministry of Higher and Secondary Specialized Education of 24 October 1984: "Report on the State of Creative Scientific and Technical Work at Secondary Specialized Educational Institutions of the Ukrainian SSR"]

[Text] In fulfilling the decisions of the 26th CPSU Congress, the June (1983) and April (1984) CPSU Central Committee plenums and the decrees of the CPSU Central Committee and the USSR Council of Ministers, which were adopted on the reform of the general educational and vocational school, the Ukrainian SSR

Ministry of Higher and Secondary Specialized Education, the sectorial ministries and departments and the collectives of secondary specialized educational institutions of the republic are performing considerable work on the further increase of the efficiency and quality of the instruction and training of students at tekhnikums and schools.

In the Ukrainian SSR the training of specialists with a secondary specialized education is being carried out in 384 specialties at 729 tekhnikums and schools with a student body of 803,400, including 508,300 day students, 79,500 evening students and 215,600 correspondence students. There are 511 educational institutions subordinate to 27 republic ministries (departments) and 218 tekhnikums and schools subordinate to 46 union ministries.

The Ukrainian SSR Ministry of Higher and Secondary Specialized Education carries out the educational methods supervision of secondary specialized educational institutions through the republic sectorial ministries and departments, their educational methods offices, the oblast councils of directors and the oblast (city) base tekhnikums and schools.

Here much attention is being devoted to the improvement of the methods of instruction with the extensive use in the educational process of educational methods complexes, teaching equipment, computer technology and simulators and to the conducting of business games and classes in the laboratories and shops and enterprises with the use of production situations.

The system of the creative scientific and technical work of students and instructors, which has formed at the secondary specialized educational institutions of the republic, is based on the content of the educational process and is implemented during the entire period of instruction with allowance made for the age peculiarities and individual inclinations of the students, is conducive to the cultivation of the creative activeness and the extension of the knowledge of student youth in their training for practical activity.

The Collegium of the Ukrainian SSR Ministry of Higher and Secondary Specialized Education in 1980 specified creative technical work as an integral part of the entire educational and training process, which contributes to the inculcation in students of the skills of efficiency promotion and inventing, knowledge in the area of patent studies and license work and the skills to improve production processes.

In conformity with this the elective subjects "The Principles of Creative Technical Work" (for technical specialties) and "The Pilot Experimental Work of the Specialist" (for nontechnical specialties) covering 20 hours, the programs of which were elaborated jointly by the Republic Scientific Methods Office for Secondary Specialized Education, scientists of Kiev Polytechnical Institute and instructors of a number of tekhnikums, were introduced for the first time in the country at tekhnikums and schools of the republic. At present these subjects are being given in the upper classes at more than 250 secondary specialized educational institutions of the Ukrainian SSR. The materials of the base enterprises on efficiency promotion and inventing, as

well as the latest achievements of science and technology are used widely when studying this course and elaborating individual assignments of students on creative technical work.

The republic section of the creative scientific and technical work of students is playing a significant role in the organization of the creative scientific and technical work of students of secondary specialized educational institutions of the Ukrainian SSR. Workers of the Ukrainian SSR Ministry of Higher and Secondary Specialized Education and the leading sectorial ministries and departments of the Ukrainian SSR, the chairmen of the oblast sections, the supervisors of creative technical work of a number of tekhnikums and Komsomol and trade union workers are included in it.

The section carries out the organizational methods supervision of this work regardless of the departmental subordination of the educational institutions through the oblast sections of creative scientific and technical work, annually makes an analysis of this work in the republic and formulates procedural recommendations to aid the supervisors of the creative scientific and technical work of students.

At present the number of students of secondary specialized educational institutions of the Ukraine, who are engaging in creative scientific and technical work, has reached 248,000, or 48.8 percent of the contingent of day departments.

Subject circles and specialty circles are one of the most massive forms of creative technical work. During the 1983/84 school year more than 15,000 circles, in which about 238,000 people took part, were active at the tekhnikums and schools of the republic.

The work in the circles is aimed at the improvement of the supply of their own material and technical base, as well as at the fulfillment of the assignments of the base enterprises and the orders of other educational institutions.

In all during the 1983/84 school year more than 26,000 instruments, mock-ups, controlling machines, laboratory stands, units and visual aids, which are used in the educational process, were produced in the republic by circle members.

Throughout the republic 60.8 percent of the permanent instructions, as well as 895 specialists of industrial enterprises were enlisted in the supervision of subject and technical circles.

The role of the subject (cycle) commissions for the organization and holding of competitions among students--"Best in the Subject," "Best in the Occupation"--has increased. During the 1983/84 school year 62.5 percent of the students at the secondary specialized educational institutions of the Ukrainian SSR Ministry of Higher and Secondary Specialized Education and 58.8 percent at educational institutions of republic subordination were encompassed by the competitions.

The exhibitions, which are held systematically by the sectorial ministries and departments and oblast sections of the creative scientific and technical work

of students, are giving much assistance in the promotion of creative scientific and technical work. Exhibitions of the creative technical work students of tekhnikums of the Ukrainian SSR Ministry of Ferrous Metallurgy, the Ukrainian SSR Ministry of Agriculture and a number of other ministries operate permanently in the republic. Seminars and excursions are being conducted on their basis. Each exhibition is regularly updated, which makes it possible to show the increase of the skill of collectives and their role in the improvement of the creative scientific and technical work of students.

The fulfillment by students of assignments of a research nature and participation in efficiency promotion and inventing during the period of practical technological work at a works have become an integral part of the work of secondary specialized educational institutions of the Ukrainian SSR.

The share of economic research has increased significantly, the attention of the participants in the creative scientific and technical work of students to the accomplishment of the Food Program has been increased. The students of the Bucha Sovkhoz-Tekhnikum under the supervision of instructor A. M. Derevyanin achieved good results. In accordance with the materials of their research the scientific articles "The Usefulness of the Podsolized Soils of the Western Forest Steppe Under Apple Tree Plantings" and "The Influence of Forms of Potassium Fertilizers on the Yield of Strawberries" were published in the journal VESTNIK SELSKOKHOZYAYSTVENNOY NAUKI. As a whole for the republic in 1983 alone more than 2,500 efficiency proposals, which yielded a significant economic impact, were submitted during the period of the performance of practical production work. In all 57 works of students (or in collaboration with students) were published in the press, 44 certificates of authorship were received, including 20 certificates received by students of 5 tekhnikums of Odessa.

The following figures attest to the increased activeness of students of the Ukraine in inventing work: during the 1980/81 school year 960 proposals with an economic impact of 134,100 rubles were submitted, while during the 1983/84 school year 1,601 proposals with an economic impact of 405,800 rubles were submitted. The work under the Comrade Yu. A. Koroshchenko, an instructor of the Zhdanov Tekhnikum of Urban Electric Transport, as a result of the introduction of which at the Ukrlift and Donetsklift trusts a large economic impact was obtained, is significant in this direction.

Experimental design bureaus, the activity of which is closely connected with the development of educational laboratory equipment, as well as the performance in accordance with the orders of enterprises of operations which are of great national economic importance, hold an important place among the forms of the organization of the creative work of students. Thus, during the 1983/84 school year the students of 128 experimental design bureaus of secondary specialized educational institutions of the Ukraine fulfilled 590 economic contractual themes.

The joint work of the student experimental design workshop of the Lvov Tekhnikum of Rural Construction and the planning and design bureau (SPKB) of Lvov Polytechnical Institute on the elaboration and implementation of ordered industrial plans showed itself to advantage.

During the 1983/84 school year on the basis of a contract of creative cooperation of the higher educational institution and the tekhnikum 6 undergraduates and 40 students and respectively 10 and 15 workers of the educational institutions worked on a joint theme. The planning estimates in the amount of 10,000 rubles were fulfilled. Moreover, practicable course and graduation designing was used extensively for elaborating the economic contractual themes.

In recent times the number of graduation projects of students, which include individual assignments on creative technical work, has increased at the tekhnikums and schools of the Ukrainian SSR. In 1984 one graduate in four worked on the fulfillment of an individual assignment on creative technical work. The introduction of creative technical work in the educational process is contributing to the increase of the number of graduation projects which have been recommended for introduction in production. In 1983/83 it came to 11.3 percent of the total number of defended projects.

For example, at the Kharkov Mechanical Technological Tekhnikum in 1983 the city control commission recommended 128 graduation projects for introduction in production. A group of students of the Lvov Tekhnikum of Rail Transport produced a car simulator for the Main Lvov station. At the Zaporozhye Tekhnikum of Electronic Instruments 45 percent of the graduation works were recommended by the city commission of experts for introduction in production, among them the development of student B. A. Svyatodukh, which increased significantly the output in work of microcircuits at the base enterprise, is of the greatest interest. A large number of practicable graduation projects, which were developed by students of the tekhnikums of Odessa, Dnepropetrovsk and Donetsk oblasts, are also finding use in production.

The active work of public organizations of scientific and technical societies and the All-Union Society of Inventors and Efficiency Experts is contributing to the increase of the effectiveness of the work on the creative scientific and technical work of students. The primary organizations of scientific and technical societies and the All-Union Society of Inventors and Efficiency Experts of secondary specialized educational institutions are giving assistance to the administration of tekhnikums and the councils of the creative scientific and technical work of students in the preparation and introduction of practical laboratory studies on the development of new equipment, are holding consultations for instructors on its use, are enlisting in their holding experienced specialists of sectorial enterprises and others.

The experience of the work of the primary organization of the Scientific and Technical Society of Radio Engineering, Electronics and Communications imeni A. S. Popov of the Kharkov Electrical Tekhnikum of Communications on the enlistment of students in creative technical work, which was endorsed by the All-Union Council of Scientific and Technical Societies, is of the greatest interest.

The primary organization of the scientific and technical society of the Kharkov Electrical Tekhnikum of Communications unites 728 members of the society, including 63 instructors and other associates of the tekhnikum (70 percent of the total number of instructors and engineering and technical

personnel) and 665 students (75 percent of the total number of students of the tekhnikum). The educational receiver for training in the assembly of electrical circuits and the Bolshaya Moskva complex of laboratory operations on the installation, setting up and tuning of television equipment are grouped with the most interesting operations which were performed under the supervision of active members of the primary organization of the scientific and technical society.

The work being performed by the Ukrainian SSR Ministry of Higher and Secondary Specialized Education on the introduction of the system of the organization of the creative scientific and technical work of students at secondary specialized educational institutions in many respects is contributing to the increase of the quality of the training of middle-level specialists, the increase of the qualitative indicators of progress in studies and the decrease of the dropout rate. The absolute progress for the republic during the 1983/83 school year came to 98.7 percent, including qualitative progress in studies of 54 percent and a dropout rate of students of 2.8 percent.

The joint work of collectives of tekhnikums with scientific and technical societies is contributing to the increase of the number of classes, which are conducted with the use of teaching equipment, the number of graduation projects, which have been defended with a rating of "good" and "excellent" and have been recommended by the city control commission for introduction in production, is increasing.

At the same time shortcomings and unused reserves exist in the activity of secondary specialized educational institutions of the republic on the development of the creative scientific and technical work of students.

The enlistment of students in creative scientific and technical work is not of a mass nature.

In several ministries, departments, councils of directors of secondary specialized educational institutions and collectives of tekhnikums and schools the long-range planning of this work has not been organized and the procedural principles of the creative scientific and technical work of students are being inadequately formulated.

The formal attitude of instructors to the organization and supervision of creative technical work has not yet been eliminated everywhere. The creative scientific and technical work of students during practical production work is being organized not always efficiently and often in isolation from the labor collectives. Procedural and organizational questions have been inadequately elaborated.

Experimental design work is still being developed slowly and elements of creative work are still being introduced slowly in the educational process. The Ukrainian SSR Ministry of Higher and Secondary Specialized Education needs to study more extensively and to disseminate the advanced know-how of tekhnikums and schools on the organization of the creative scientific and technical work of students and to attract more representatives of production

and instructors of higher educational institutions for the joint performance of design and research work with the collectives of tekhnikums and schools.

The efficient monitoring of the state of the creative scientific and technical work of students at educational institutions of sectorial ministries and departments has not been organized. The Republic Inspectorate of Secondary Specialized Educational Institutions is being poorly enlisted in it.

The questions of joint work with the public organizations of scientific and technical societies and the All-Union Society of Inventors and Efficiency Experts require the further increase of attention.

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AUTOMATION AND INFORMATION POLICY

PATENT SERVICE OF ALL-UNION ELECTRICAL ENGINEERING INSTITUTE

Moscow IZVESTIYA in Russian 16 Apr 85 p 3

[Article by S. Osminina: "Is the New Equipment New?"

[Text] We often say: a high level of equipment, scientific research. But every person can understand "a high level" in his own way. One institute obtains for its developments licenses from foreign countries, another does not set itself such a goal. Or, for example, from year to year they modernize at an association a once assimilated model and are confident that they are developing new equipment.

Does it exist at all--an objective criterion of the evaluation of the level of a new scientific idea or a technical innovation, the level of a product, and through it the activity of a scientific production subdivision? Is it possible to measure its height?

I attempted to get an answer to this question at the VEI--the All-Union Electrical Engineering Institute of the Ministry of the Electrical Equipment Industry.

The choice was not by chance. In the patent department of this institute there are 15 people headed by Nadezhda Ivanovna Morozova--the permanent director for 20 years now. Everything begins with them and also ends with them--thus Deputy Director for Science M. I. Bortnik defined the role of the patent service in the life of the institute. At the All-Union Electrical Engineering Institute, as at many (unfortunately, far from all) sectorial institutes, the patent service takes part in the creation of innovations at all the stages of development, constantly checking its level against the world level.

Once every 6 months several pages of typed text, which are tediously called "Reports," fall on the desk of the director of the All-Union Electrical Engineering Institute. But this document is worth becoming acquainted with in greater detail.

"The analysis of the technical decisions showed that we are lagging in the elaboration of this theme in general and the specific problem, in particular," it is reported in the text.

On another theme: "The number of technical decisions, which are declared annually by associates of the All-Union Electrical Engineering Institute on this problem, during the past five-year plan increased by threefold and amounts to approximately 30 percent of all the technical decisions in the world.... The problem is being actively developed and has not reached the maximum in its development. One should group among the most promising means of its solution..." (a list follows).

There is another statement: "The instruments and technologies, which have been developed at the All-Union Electrical Engineering Institute, are protected by certificates of authorship. However, there are no fundamental decisions which specify the promising directions."

Who is it that decided to be a strict judge of the directions of the activity of the institute, literally every theme of it? Now, do you see, the All-Union Electrical Engineering Institute is not pulling up to the world level, now there are many inventions, but their quality is wrong. And even where everything, it would seem, is in order, there is caution: the problem is being actively developed, see that they would not surpass you, the best roads are such and such.

Only patent experts could perform such work. And its results are telling. Here are the statistics of last year: at the All-Union Electrical Engineering Institute 54 themes capable of protection, in accordance with which 143 inventions were developed and 21 developments, in which 48 inventions were used, were assimilated by production, were completed, 17 foreign patents were obtained and 1 license was sold.

Even on the surface these figures look impressive. But let us try to evaluate more thoroughly the creative output of scientists. For all inventions are not alike. Behind some are fundamentally new means of development, behind others is the improvement of secondary parts. At the All-Union Electrical Engineering Institute they developed such a system of accounting, which makes it possible to evaluate (in points) the very quality of inventing activity and thereby the level of the creative productivity of the institute's subdivisions. Here the significance of the inventions, the importance of the problem being solved, the proposed extent of introduction and the anticipated economic impact are taken into account.

The patent service of the All-Union Electrical Engineering Institute checks against the world level each development at all the stages of its evolution and twice a year analyzes the progress of individual themes (and thereby the level of the work of the scientific subdivisions attached to them). These are external indicators. But in addition to them internal, not less important estimates of the creative output of the subdivisions of the institute were also introduced.

The experience of the All-Union Electrical Engineering Institute shows: the monitoring of the level of developments and its management are tasks which should be accomplished with the assistance of the patent service.

As a whole it has 500,000 foreign patents, which constitute the sectorial holdings which were collected over 20 years (each year they are supplemented by 15,000). It is not a simple matter to get one's bearings in this boundless sea and to find promptly what is needed. The department conducts patent studies on global problems of electrical engineering. In order to get an idea of the volume of this work, I will say that, for example, when developing a high-voltage thyristor rectifier 4,890 patents were selected for analysis, they contained information on 3,079 technical decisions.

The search for, selection and analysis of patent documents, as well as the search for and analysis of various types of market information are the job of patent experts. But when it comes to the technical analysis and formulation of conclusions, the work becomes joint work, here one cannot do without designers. The very reference point for all evaluations and recommendations, which is nothing other than the world level, is established by common efforts. Not such a level as one worker or another understands it, but a level objectively established as a result of thorough patent studies.

Requests for the results of the patent studies of the All-Union Electrical Engineering Institute (and these are fat volumes) come from many organizations at which they develop equipment. Frequently their number reaches several tens. This interest is understandable. Why conduct studies over again?

The more extensive exchange of the results of patent research among sectors would drastically shorten the time of research and would make it possible to intensify it, the patent experts of the All-Union Electrical Engineering Institute believe--coordination on the scale of the country is necessary here.

And, of course, they are right. But this is just one of the questions, which, naturally, arises as soon as we go beyond the individual institute. Here is another: Why not use (with the appropriate modification) the experience of managing the level of the equipment being developed, which is found in the leading collectives of the country, on a broader scale--on a statewide scale? Then it will be possible to see clearly the tomorrow of the development of modern equipment.

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CONFERENCES AND EXPOSITIONS

GENERAL MEETING OF BELORUSSIAN SCIENCE ACADEMY NOTES SCIENTISTS' CONTRIBUTION TO FIVE-YEAR PLAN

Minsk SOVETSKAYA BELORUSSIYA in Russian 23 Mar 85 p 3

[Article by Belorussian News Agency: "Scientists and the Five-Year Plan--Science Is Wearing Special Work Clothes--Session of Annual General Meeting of Belorussian Academy of Sciences]

[Text] To advance to the frontmost scientific and technological lines and to the world's highest level of productivity of social labor within a short time--such is the brief but descriptive formulation of one of the main tasks for socioeconomic development of our country at the special March (1985) Plenum of the CPSU Central Committee. Its implementation would be inconceivable without fruitful basic and applied research. What is being done by the scientists of Belorussia for successful and rapid implementation of the party's order, how is academic science preparing to solve major problems of the next five-year plan, what are the new forms of scientific organizational work and the most effective means of introducing achievements to practice? There was a strict conversation about this at the session of the annual meeting of the Belorussian Academy of Sciences, which convened in Minsk.

In his opening remarks at the session, Academician N. A. Borisevich, president of the Belorussian Academy of Sciences, remarked that 1984 was, like prior years, marked by intensive and creative research, which yielded good results. B. V. Bokut', academician of the Belorussian Academy of States was the recipient of the USSR State Prize. He made a large contribution to theory of nonlinear optical phenomena, while the research he pursued with his co-authors was the basis for development and manufacture of nonlinear devices and lasers with adjustable radiation frequency.

A large group of scientists were the recipients of the Belorussian State Prize. The 1984 USSR Council of Ministers Prize was bestowed upon Belorussian researchers for development and practical implementation of new methods and equipment to restore and strengthen parts of electric contact welding machines for filler materials. The developments of young academy associates were awarded two Lenin Komsomol prizes and two Lenin Komsomol of Belorussia prizes.

The following facts are also indicative of the fruitfulness of last year for the personnel of the Academy of Sciences: 360 books and pamphlets and almost

5000 scientific articles were published; 886 author certificates were issued for inventions. There have been some positive changes in patenting and licensing work.

The Academy is participating in development of most of the republic-level and regional scientific and technological programs for 1986-1990, which cover all the basic directions of scientific and technological progress in this republic. It would be inconceivable to solve the key problems of scientific and technological progress without basically new scientific concepts, major discoveries and inventions. For this reason, development of basic research and revision of its topics are the main concern of Belorussian scientists.

N. A. Borisevich concluded that the scientists of the Academy of Sciences will apply every effort to welcome the coming 27th CPSU Congress with new deeds.

V. A. Pilipovich, chief scientific secretary of the presidium of the Belorussian Academy of Sciences, academician of the Belorussian Academy of Sciences, delivered a paper on the scientific and scientific-administrative performance of the academy in 1984.

He stated that, last year, several important scientific problems in both the area of social and natural sciences were solved in academy institutions. In this time, tens of new instruments, machines and technological processes were developed and introduced to the national economy. Belorussian scientists worked on several dozen All-Union and republic-level scientific-technical, economic and combined programs. It is rewarding to see the significant results obtained on the Algebra and Number Theory, Spectroscopy, Crystal and other programs.

The set of studies conducted on the Energy program furnished this republic's industry with new, highly efficient heat-mass-exchange technologies and equipment, including some that utilizes secondary energy resources and the energy of renewable sources.

Having studied many phenomena that arise with interaction of polymers with metals, silicates and wood, scientists who completed the Composites program established the basic patterns of friction and wear of composition materials. Researchers working on processes of nuclear energy advanced and validated the concept of simultaneous production of low-potential heat and reproduction of nuclear fuel at nuclear heat supply plants with fast breeder reactor.

In the area of chemical sciences, studies were continued, the purpose of which was to develop new catalysts and adsorbents, methods for synthesis of multifunctional organic and inorganic compounds with a specified set of useful properties needed by man. Biologists obtained new data on genetic control of plant characters related to grain yield; new methods of breeding self-pollinating crops were developed. Promising specimens of yellow lupin were found, and recommendations were prepared on their use to develop highly productive hybrids. Breeders have also delivered the best short-stemmed rye specimens. Studies were conducted within the framework of the Regulation-2 program, the results of which could serve as the basis of new methods of treating vascular diseases.

V. A. Pilipovich informed the meeting that work had been completed within the Culture program on preparation of a 7-volume guide to historical and cultural monuments of Belorussia. This is an important stage in the study of the cultural heritage of the Belorussian people.

In 1984, the economic impact from introducing the achievements of scientists to industry constituted more than 190 million rubles. There were appreciable advances in refinement of the mechanism of transmitting academic developments to the national economy. The speaker and participants at the session analyzed in detail questions of expanding scientific and technical collaboration of the academy with enterprises and organizations in the republic. The volume of work done by economic agreement constituted 7.4 million rubles in 1984, which is almost a million rubles more than the preceding year. Almost one-third of the more than 800 assignments performed by the institutes were covered by economic agreements made with enterprises in the republic.

Last year, the greatest effect was obtained from creative ties between academic institutes and the republic's largest associations and enterprises. For example, use of investigations pursued specially for BelavtoMAZ [Belorussian MAZ Automobile Plant] yielded 7.4 million rubles profit for the association. Merely by introducing innovations of the Institute of Problems of Reliability and Durability of Automobiles, which made it possible to upgrade the design of assemblies and lower the use of materials in automobiles, there was a gain of more than 2 million rubles. The same institute is actively introducing its developments to other enterprises in this republic. Use at the Minsk Tractor Plant of methods developed by the institute for determination of loads and estimation of reliability of the main transmission elements, choice of gear box systems and other innovations prolonged significantly the durability of tractor parts.

It was noted that Belorussian scientists are also making their contribution to implementation of the nation's Food Program. The Institute of Experimental Botany imeni V. F. Kuprevich has transmitted to kolkhozes and sovkhozes, as well as the Belorussian Scientific Research Institute of Agriculture under the Belorussian Ministry of Agriculture, recommendations on use of chemical growth regulators and herbicides on fields of agricultural crops, methods of grading potatoes, lupin and clover for breeding. The economic impact of using the innovations of botanists was 564,000 rubles.

A new dry feed product, provilakt, and liquid feed preparation, promiks, were developed at the Institute of Microbiology. Construction has begun on a shop for production of promix in Baranovichskiy Rayon.

The speakers indicated that it is possible to improve planning of economic agreements, coordination and integration of work, expand scientific and technical ties to chief organizations of the sectors, as well as increase sector introductions, thanks to the collaboration of the Belorussian Academy of Sciences with Union and republic ministries and agencies and the largest production associations. The collaboration with the Ministry of the Machine Tool and Tool Building Industry of the Integral, BelavtoMAZ and BelOMO [expansion unknown] production associations can serve as an example. Thus,

establishment of the Avtofiztekh Production Association (Belorussian Academy of Sciences--BelavtoMAZ Production Association) made it possible to accelerate the passage of innovations from the laboratory to the shop and improve joint developments. As a result, a new family of large-tonnage trucks and articulated trucks were developed. Their appearance on the nation's roads and construction sites of the national economy will lower current expenses for operating vehicles, increase the freight turnover of the truck fleet and yield a significant fuel saving.

It was observed that, in the period under review, there was continued collaboration of institutions of the Belorussian Academy of Sciences with institutes of the academies of sciences of the Ukraine, Moldavia, Lithuania, Latvia, Tajikistan and Armenia on the basis of coordinated plans; joint research with foreign scientists was also conducted.

It was indicated at the meeting that, along with achievements, there are also flaws in the performance of the academy. It was stated that the chief organizations for the republic's most important integrated programs in the area of natural and social sciences and the scientific councils that coordinate the research on these programs do not make full advantage of the special-purpose program method of planning. They often have a formal approach to selection and formation of topics and they do not analyze the results obtained. The directions of these investigations do not implement performance of a single end task. And, of course, the results are disparate and do not permit deriving theoretically and practically important generalizing conclusions. In particular, combined studies pursued by several institutions are not sufficiently represented in the programs. VUZ scientists, particularly employees of peripheral institutes, are not called upon sufficiently to participate in combined research.

Quite a few questions also arise when we examine the list of the most important problems in the area of natural, engineering and social sciences that must be solved under the next five-year plan. It was stated from the podium at the meeting that departments, chief organizations and the presidium of the Belorussian Academy of Sciences must rapidly analyze all of the topics, eliminate trivial ones from the plans, give priority to significant combined and pressing investigations within the immediate future.

There was discussion at the session of the need to increase the effectiveness of using computers when conducting research and organize extensive training for specialists in different sectors in use of personal computers. It was recommended that the Institute of Mathematics expedite establishment of a regional computer network.

Having analyzed work in the area of inventions and patenting-licensing, the speakers stated that there are also reserves here. The coefficient of use of inventions in the national economy is still low. By far not all of the institutes participate in work dealing with patenting and commercial realization of inventions.

There was criticism of the work dealing with training and placement of cadres. Speakers called attention to the fact that little study is made of business and moral-ideological qualities when workers are promoted. Yet, this leads to the fact that people who are unable to perform the assigned segment of work are sometimes found in administrative positions.

The following participated in discussing the report on the performance of the Belorussian Academy of Sciences in 1984: A. S. Dmitriyev, vice-president of the Belorussian Academy of Sciences and academician of this academy; F. I. Fedorov, academician-secretary in the Department of Physical and Mathematical Sciences, academician of the Belorussian Academy of Sciences; L. V. Khotyleva, director of the Institute of Genetics and Cytology, academician of the Belorussian Academy of Sciences; G. A. Anisovich, chief of the Mogilev Department of the Physico-technical Institute, academician of the Belorussian Academy of Sciences; Ye. M. Babosov, director of the Institute of Philosophy and Law, corresponding member of the Belorussian Academy of Sciences; O. I. Semenkov, director of the Institute of Technical Cybernetics; and M. S. Vysotskiy, chief designer in the BelavtoMAZ Production Association, corresponding member of the Belorussian Academy of Sciences.

Scientific papers were delivered. A. A. Akhrem, academician of the Belorussian Academy of Sciences told about the radioimmunological method of microanalysis in medicine. The subject of A. G. Lobanok, corresponding member of the Belorussian Academy of Sciences, was biotechnology--problems and prospects. V. P. Gribkovskiy, corresponding member of the Belorussian Academy of Sciences, delivered a paper entitled "Streamers in Semiconductors--Cooperative Self-Organized Processes."

This ended the session of the annual general meeting of the Belorussian Academy of Sciences.

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CONFERENCES AND EXPOSITIONS

KAZAKH ACADEMY OF SCIENCES MEETING DISCUSSES SCIENCE, TECHNOLOGY ADVANCES

Alma-Ata KAZAKHSTANSKAYA PRAVDA in Russian 12 Apr 85 pp 1, 3

[Article by Kazakh News Agency: "Toward Leading Scientific and Technological Positions"]

[Text] The scientists of our republic are making a significant and constantly increasing contribution to acceleration of scientific and technological progress, solution of major socioeconomic and cultural problems spelled out by the 26th Congress, subsequent plenums of the CPSU Central Committee and 15th Congress of the CPKaz [communist party of Kazakh SSR]. As they constantly strive toward approximation of science and industry, they help build up labor productivity, improve the quality of manufactured products and lower its cost and better meet the growing needs of the public. Along with applied investigations, basic research is developing, which helps in further rise of all of Soviet science.

The achievements of Kazakhstan scientists are unquestionable, but at the same time there is still much for them to accomplish to expand and improve the effectiveness of their work and expedite introduction of its results to practice.

On 11 April, a session of the general meeting of the Kazakh Academy of Sciences convened in Alma-Ata, which discussed the achievements of the academy in the past year and defined steps for further development of science in this republic.

The presidium of the meeting consisted of the following people: comrade D. A. KUNAYEV, member of the Politburo of the CPSU Central Committee and first secretary of the Central Committee CPKaz; N. A. NAZARBAYEV, chairman of the Kazakh Council of Ministers; O. S. MIROSHKHIN, second secretary of the Central Committee CPKaz; members of the presidium of the Kazakh Academy of Sciences, administrators of several ministries and agencies, party, soviet and Komsomol officials.

Academician A. M. KUNAYEV, president of the Kazakh Academy of Sciences, delivered the opening remarks at the session. He said that the Soviet people unanimously approved the decision of the special March Plenum of the CPSU Central Committee, which elected comrade M. S. Gorbachev general secretary of

the CPSU Central Committee and are struggling more and more actively for the triumph of communistic ideals.

For the employees of the republic's Academy of Sciences, last year was busy with major work to implement the party's decisions aimed at acceleration of scientific and technological progress, increased effectiveness of research and reduction of delay in introducing scientific achievements to industry. Constant attention was devoted to strengthening management and order on all levels of the academic system, as well as increasing employee responsibility for the work assigned to them.

It was stressed at the March (1985) Plenum of the CPSU Central Committee that we must obtain a decisive turn with respect to putting the national economy on the tracks of intensive development. We must, we are compelled to advance to the very front scientific and technological lines within a short time, to the highest world level of social labor productivity.

Soviet scientists view this as a concrete program for their work to accelerate as much as possible scientific and technological progress, develop new technological processes, methods of intensification of production, wise use of natural resources, which are all ultimately aimed at increasing labor productivity.

The 16th plenum of the Central Committee CPKa directed the party organization and academy administration toward comprehensive improvement of work with cadres, increase in their administrative and educating role. There is still much to do to improve ideological work. The increasing demands for such work were clearly defined in the decisions of the June (1983) Plenum of the CPSU Central Committee and in the speech of comrade M. S. Gorbachev at the All-Union Scientific and Practical Conference. The Presidium of the Kazakh Academy of Sciences devotes much attention to further development of investigations in the area of social sciences.

Together with all of the Soviet people, the employees of academy institutions are celebrating in a worthy fashion the 40th anniversary of the victory of the Soviet people in the Great Patriotic War and they are striving to mark this glorious jubilee with new achievements.

It was stressed that Lenin's precept had unwaning significance--"Labor productivity is ultimately the most important thing for victory, for a new social regime." And today, cardinal increase in labor productivity is the key task in the national struggle for maximum possible growth in effectiveness of social production, the basis for strengthening the economic and defense power of the nation, for further raising the people's standard of living.

Scientists must play an important part in reaching this goal. They are called upon to furnish to the national economy the appropriate methods, develop equipment and technology that would provide for a drastic increase in labor productivity. But if we were to examine the subject matter of research done at academy institutes from this point of view, we would notice that there are still too few studies aimed directly at increasing labor productivity.

Institutes that are working on development of new industrial technology must develop the most actively and introduce their results at more than one enterprise, to an entire sector. Expressly this determines the national economic effect of a given innovation. One must expand as much as possible the area of introduction, and involve sector ministry personnel in this work. Only if the work is set up in this way can we expect to increase the role of scientists in accelerating scientific and technological progress.

Attention was called to the lag of the experimental base. It is imperative to make fuller use of all opportunities for experimental work, also keeping in mind appropriate shops and base enterprises under republic ministries, their practical assistance in production and installation of equipment. The effectiveness of scientists in the system of the Ministry of Higher and Secondary Specialized Education of this republic should also be increased.

The Presidium of the Kazakh Academy of Sciences recently examined the report of the Central Kazakhstan Department of the Academy, which is located in Karaganda. Along with achievements, there are flaws there. The great practical assistance that this department receives from party and soviet agencies provides for further improvement of its performance. The Central Kazakhstan Department must take full advantage of the favorable conditions for development of an experimental base. Being situated in the middle of a major industrial region with modern enterprises for recovering coal, production of ferrous and nonferrous metal and a building industry, it is called upon to devote special attention to solving problems related to this and become the organizer of the first scientific production association in this republic's Academy of Sciences.

With each year, the indicators of utilizing the results of research in industry are rising in the system of the Kazakh Academy of Sciences. Direct contact of scientific institutions with ministries and agencies, by means of joint investigations, is strengthening. However, fuller use should be made of the opportunities in this important work.

Economic effectiveness and practical return in general have always been the deciding criterion in assessing the performance of scientists. In our times, special significance is attributed to this, since science has been given such pressing tasks as intensification of production, combined use of natural resources and environmental protection.

In the light of implementation of the Food and Energy programs, administrators of projects, laboratories and institutes must be more persistent in seeing to it that investigations are better included in solving relevant problems. Conditions for successful utilization of research results are provided already when it is planned and when the goals and tasks are defined. There must be a stricter approach to formation of the thematic plan in combined research programs.

The report of N. K. NADIROV, chief scientific secretary of the Presidium of the Kazakh Academy of Sciences and academician of this academy, concerning the performance of the academy in 1984 mentioned the great attention that had been given in the period under review to further coordination of efforts

applied by this republic's scientists to solve important problems of the national economy and increase the effectiveness of research. There was strengthening of creative contacts with ministries and agencies, enterprises and organizations. The academy completed investigations on 70 topics. A total of 100 topics were investigated in accordance with the State Plan for Economic and Social Development of Kazakh SSR. Much was done to implement the programs of the USSR State Committee for Science and Technology and the presidium of the USSR Academy of Sciences.

Much work on uniting the efforts of scientists and strengthening ties of science with industry is being done by a permanent commission for introduction of results of scientific research under the presidium of the Kazakh Academy of Sciences. With its help, a number of major developments of institutes are becoming the property of industry.

Important results have been obtained from investigations that are significant to both science and different sectors of the national economy and culture. Special mention should be made of the importance of work dealing with development of a new system of reclaiming land differing in condition, intensifying cultivation of wheat and other crops. Work was continued in the area of breeding, improving and introducing new breeds of farm animals.

Subterranean water is acquiring increasing significance to the republic's economy. Studies have been finished on regional evaluation of use of such water under different environmental conditions for water systems, flooding desert pastures and irrigating land, as well as further development of feed production. The personnel of academy institutions have also made a significant contribution to expansion of the mineral raw materials base, having prepared forecasts on future increment of stock of nonferrous, rare and precious metals for different regions. An effective scientific search is being pursued to develop progressive technological processes.

Some advances have been made in the area of nuclear physics, mechanics, computer and applied mathematics, catalysis and other sciences. There was significant activation of activities of institutes in the Department of Social Sciences to implement the decisions of the June (1983) Plenum of the CPSU Central Committee. Thus, the distinctions of reproduction and use of manpower resources under conditions of intensive development of the economy of Kazakhstan were defined. At the present time, on the eve of the 40th anniversary of the victory of the Soviet people in the Great Patriotic war, an in-depth investigation of the role of Soviet Kazakhstan in the defense of our socialist homeland was timely.

Several major studies were conducted by archeologists, literary historians, specialists in linguistics and law, and historians.

Having noted that the Central Kazakhstan Department of the Academy of Sciences continued some important and interesting studies dealing with development of technology for combined and waste-free processing of polymetal raw materials, the speaker then stressed that on the whole there was considerable strengthening of the academy's ties with industry in the period under review.

While 193 developments of academy institutions had been used in this republic's national economy in 1983, in 1984 there were 231, with an annual economic effect of 126 million rubles. A total of 260 author certificates and 5 patents from foreign patent agencies were received. The largest number of introduced innovations pertained to development of nonferrous and ferrous metallurgy, agriculture, chemical, petroleum and oil refining industries, as well as geology. With regard to commercial realization of inventions abroad, the Institute of Metallurgy and Ore Dressing prepared contracts that have been made.

Bestowing orders and medals of the USSR and awards of Kazakh SSR has become a worthy recognition of the achievements of a number of scientific institutions and individual scientists. The institutes of nuclear physics, mathematics and mechanics, geological sciences, mining, metallurgy and ore dressing, organic catalysis and electrochemistry, petroleum and natural salts chemistry, zoology, botany, philosophy and law, economics manifested particularly high activity in the area of improving scientific-organizational work and effectiveness of its results.

There was further, appreciable development of the academy's contacts with foreign colleagues. Some work is being done on disseminating information about the achievements of Kazakh scientists.

The academy's scientific and technical base is growing and developing, training of scientific personnel is improving. In the period under review, more than 200 of its staff members defended doctoral and candidatorial dissertations.

At the same time, there are still unused reserves in academy institutes. Not enough attention is being given to inclusion of scientific research in the plan of economic and social development of this republic. At some of the institutes work on patenting inventions abroad has not been properly set up, not enough concern is shown about development of inventions, use of modern computers that would accelerate development of some projects or other. There is slow development of some new scientific directions. More work should be done on development of highly productive energy- and materials-conserving, waste-free technologies or those involving little waste.

Academicians of the Kazakh Academy of Sciences--U. M. SULTANGAZIN, D. V. SOKOL'SKIY, A. N. ILYALETDINOV, ZH. M. ABDIL'DIN--and corresponding members of this republic's Academy of Sciences--SH. G. BOLGOZHIN and I. O. BAYTULIN--who spoke at the session described in detail the performance of institutes and laboratories, mentioned the basic reasons for flaws and oversights, the means of overcoming them, of further development of research, concentration of efforts on the most important scientific directions. They exchanged know-how, analyzed the poosibilities for further increasing the contribution of scientists to fulfillment of the tasks under the current five-year plan and in the future. K. U. MEDEUBEKOV, academician of VASKhNIL [All-Union Academy of Agricultural Sciences imeni Lenin], chairman of the presidium of the Eastern Department of VASKhNIL, dwelled on the need for further joint investigations dealing with problems related to implementation of the USSR Food Program.

The session adopted a decree that made it incumbent upon the presidium, department and all institutions of the republic's academy to take effective steps to eliminate flaws, assure increased effectiveness of research, faster introduction of its results to industry and performance of sociocultural tasks, augment the role of of the Kazakh Academy of Sciences in accelerating scientific and technological progress in the light of the decisions of the 26th Party Congress and March (1985) Plenum of the CPSU Central Committee. The scientists intend to comprehensively activate scientific research in the interests of successful performance of tasks of communistic construction and worthy celebration of the 27th Congress of Lenin's Party.

Diplomas and medals were conferred upon recipients of the Chokan Valikhanov Prize, as well as medals of the Kazakh Academy of Sciences for the best student papers in 1984.

There was examination of organizational matters. The session confirmed directors for several scientific research institutes of this republic's Academy of Sciences.

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CONFERENCES AND EXPOSITIONS

UZBEK MEETING DISCUSSES NEED FOR EFFECTIVE SCIENTIFIC RESEARCH

Tashkent PRAVDA VOSTOKA in Russian 26 Mar 85 p 1

[Article by the Uzbek News Agency]

[Text] On 25 March, the annual general meeting of the Uzbek Academy of Sciences convened in Tashkent. It summed up the achievements of the republic's Academy of Sciences in the past year, outlined the routes of development of scientific research and developments in the light of the degree of the CPSU Central Committee and USSR Council of Ministers, "On steps to expedite scientific and technological progress in the national economy." In accordance with the plan for socioeconomic development of this republic, investigations were conducted in the Academy of Sciences in 47 basic directions and 35 extremely important scientific-technical developments were completed. The share of work done by economic agreement increased. More than 230 developments were introduced to different sectors of the economy and 336 others referable to former years continue to be used with an overal economic effect of 691 million rubles.

The report of P. K. Khabibullayev, president of the Uzbek Academy of Sciences and corresponding member of the USSR Academy of Sciences, and in the speeches it was stated that major tasks have been put to scientists by the March (1985) Plenum of the CPSU Central Committee and in the speech of M. S. Gorbachev, general secretary of the CPSU Central Committee. Intensive work must be done to develop key basic and applied research in order to very soon advance to the very front scientific and technological lines, to the highest level of labor productivity in the world. Special attention was given to the need to conduct deeper investigations in the area of computer hardware and automated control systems, applied mathematics and nuclear physics, radiochemistry and electronics, as well as other extremely important directions. Work must be intensified to find wise means of using new sources of energy, including solar, wind and atomic energy, develop more actively energy-conserving and waste-free technologies and intensify the search for mineral deposits.

Comprehensive intensification of agriculture and refinement of the agro-industrial complex are among the most important economic and social problems of developed socialism. In 1984, work continued to improve the efficiency of cotton-growing, livestock farming, environmental protection and safeguarding human health. More than half the area of the republic where cotton is

grown was planted with seeds of cotton cultivars developed by academy scientists. Nine new promising varieties of cotton were tested. Testing and investigation were continued of technological processes for synthesis of a number of pesticides and defoliants. A study was made of the efficacy of new, less toxic herbicides. The most promising ones are at the stage of extensive introduction to production.

It is a priority task to develop a set of measures to improve soil fertility, as well as to radically upgrade reclaimed land and its desalination. In particular, it is necessary to work on raising salt-resistant wild plants.

Scientists of the Academy of Sciences have proposed a new system of irrigated agriculture. It provides for intensive utilization of irrigated land and permits augmenting feed output by 50% and that of cotton by 5-6 quintals per hectare with concurrent reduction of labor and monetary resources. The speakers called special attention on the problem of protection of water and land resources against bacterial and chemical pollution, mineralization by drainage and sewer waters. There is also the task of developing new types of nitrogen and phosphorus fertilizers, as well as replacement of highly toxic pesticides with those that have low toxicity.

It was noted at the meeting that the scientists are not making an adequate contribution to fulfillment of the tasks in the Food Program. It is imperative to augment efforts aimed at intensification of legume, vegetable and orchard farming, development of effective agents for the control of agricultural plant diseases, particularly wilt and root rot, and to activate work for further development of livestock farming.

Under modern conditions, the significance of investigations in the area of social sciences is growing immeasurably. In 1984, scientists at institutes dealing with social sciences, in implementing the decisions of the June (1983) and subsequent plenums of the CPSU Central Committee, conducted research on the major problems related to formation of Marxist-Leninist world views among workers and improve the socialist lifestyle.

However, the level of the developments does not conform to the extent and complexity of the major problems that the party is solving in the course of improving society under developed socialism. There are no in-depth investigations in the area of theory of developed socialism. Scientific developments dealing with logic and psychology are at the inception stage. The plans for scientific research work of institutes do not reflect problems pertaining to young people.

The speakers stressed the fact that it is imperative to devote more attention to upgrading the creative activities of cadres, improve training of scientific workers and to have party organizations constantly participate in this important work.

The scientists assured those present that they would spare no effort to improve the effectiveness of scientific developments, accelerate their introduction to industry and celebrate in a worthy manner the 27th CPSU Congress.

I. B. Usmankhodzhayev, first secretary of the Uzbek Communist Party Central Committee, spoke before this republic's scientists.

Administrative issues were discussed at the meeting. G. A. Pugachenkova and M. S, Saidov, academicians of the Uzbek Academy of Sciences, were elected members of the presidium of this republic's Acadmey of Sciences.

The participants in the work of the meeting included the following: R. Kh. Abdullayeva, secretary of the Central Committee CPUz; U. U. Umarov, first secretary of the Tashkent gorkom; K. A. Akhmedov, deputy chairman of the Uzbek Council of Ministers.

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AWARDS AND PRIZES

NOMINATIONS FOR 1985 USSR STATE PRIZES IN SCIENCE, TECHNOLOGY

Moscow IZVESTIYA in Russian 4 May 85 p 3

[Article: "From the Committee for Lenin and USSR State Prizes in Science and Technology Attached to the USSR Council of Ministers"]

[Text] The Committee for Lenin and USSR State Prizes in Science and Technology attached to the USSR Council of Ministers announces that the following works have been allowed to take part in the competition for the 1985 USSR State Prizes:

1. R. A. Avarmaa, Ye. I. Alshits, L. A. Bykovskaya, A. A. Gorokhovskiy, Ya. V. Kikas, V. G. Maslov, R. I. Personov, L. A. Rebane, K. N. Solovyev, B. M. Kharlamov. "The Photochemical Branding of Stable Spectral Valleys and the Selective Spectroscopy of Complex Molecules." (A series of works.)

Submitted by the Institute of Spectroscopy of the USSR Academy of Sciences and the Institute of Physics of the Estonian SSR Academy of Sciences.

2. G. S. Baronov, A. D. Britov, B. A. Volkov, I. I. Zasavitskiy, G. A. Kalyuzhnaya, V. G. Koloshnikov, Yu. V. Kosichkin, L. N. Kurbatov, Yu. A. Kuritsyn, A. I. Nadezhdinskiy, V. U. Khattatov, A. P. Shotov. "Tunable Semiconductor A^{IV} B^{VI} Lasers and High-Resolution Molecular Spectroscopy on Their Basis." (A series of works.)

Submitted by the Physics Institute imeni P. N. Lebedev of the USSR Academy of Sciences.

3. Yu. I. Belchenko, M. D. Gadovich, I. N. Golovin, G. I. Dimov, V. G. Dudnikov, L. I. Yelizarov, V. V. Kuznetsov, V. M. Kulygin, A. A. Panasenkov, G. V. Roslyakov, N. N. Semashko, G. N. Tilinin. "The Development of Ion and Atomic Beams of High Power and Duration." (A series of works.)

Submitted by the Institute of Atomic Energy imeni I. V. Kurchatov.

4. L. M. Blinov, A. A. Vasilyev, A. A. Kovalev, N. F. Kovtonyuk, I. N. Kompanets, A. V. Parfenov, M. P. Petrov, S. A. Pikin, V. A. Pilipovich, V. M. Skorikov, S. I. Stepanov, A. V. Khomenko. "Basic Studies of Photorefractive and Liquid Crystals for Optical Information Processing Systems."

Submitted by the Physical Technical Institute imeni A. F. Ioffe of the USSR Academy of Sciences, the Physics Institute imeni P. N. Lebedev of the USSR Academy of Sciences and the Institute of Crystallography imeni A. V. Shubnikov of the USSR Academy of Sciences.

5. V. A. Gribkov, Yu. A. Zakharenkov, N. G. Kovalskiy, V. V. Korobkin, E. P. Kruglyakov, O. S. Pavlichenko, M. I. Pergament, L. N. Pyatnitskiy, A. A. Rupasov, D. A. Shcheglov, M. Ya. Shchelev. "The Development of the Fundamental Methods of Laser Diagnostics and the Study by Means of Them of Hot Plasma in a Large-Scale Physics Experiment." (A series of works.)

Submitted by the Institute of General Physics of the USSR Academy of Sciences, the Physics Institute imeni P. N. Lebedev of the USSR Academy of Sciences and the Institute of Atomic Energy imeni I. V. Kurchatov.

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65. V. P. Veyko, G. A. Kotov, B. N. Kotletsov, M. N. Libenson, V. Ye. Matyushkov, L. A. Gasparyan, V. I. Popov, Yu. P. Trizna, O. N. Selyutin, A. I. Smirnov, A. A. Shokin, B. V. Kiselev. "The Formulation of the Scientific Principles of the Technology, the Development of Automated Equipment and the Extensive Introduction of the Laser Processing of Thin-Film Components in the Production of Electronic Instruments."

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66. S. S. Glazov, A. L. Zaytsev, G. S. Ivanov-Kholodnyy, V. P. Karyagin, V. V. Kerzhanovich, V. A. Krasnopolskiy, S. S. Matyugov, V. I. Moroz, L. M. Mukhin, N. A. Savich, Z. P. Cheremukhina, O. I. Yakovlev. "The Study of the Atmosphere and Ionosphere of Venus by Means of Descent Vehicles and Satellites of the Planet."

Submitted by the Institute of Radio Engineering and Electronics of the USSR Academy of Sciences and the Institute of Space Research of the USSR Academy of Sciences.

67. V. V. Kovalenko, L. M. Polonskiy, Yu. P. Necheva, E. L. Vinogradova, A. A. Khrushchev, M. V. Besprozvannyy, I. V. Karpov, S. M. Popova, Ye. Ya. Akinin, T. M. Senchugova, V. A. Shulga. "The Development, Industrial Assimilation and Introduction in Film Making of a New Generation of Audio Engineering Equipment and the Establishment of the Base Production Complex of the Sound Studio of the Kiev Movie Studio imeni A. P. Dovzhenko."

Submitted by the USSR State Committee for Cinematography.

68. V. L. Aronovich, B. P. Bulatov, V. Yu. Dedy, G. G. Kozlov, V. A. Maksimov, B. F. Suslikov, V. Ya. Nagornyy, U. M. Nasyrov, L. F. Ponomarev,

S. A. Ponomarev, Yu. V. Reutskiy, A. I. Shilov. "The Development of Radioisotope Units for the Automatic Determination of the Content of Nonferrous Metals in Moving Containers and the Introduction on Their Basis of Processes of the Grading and Quality Control of Ore."

Submitted by the Almalyk Mining and Metallurgical Combine imeni V. I. Lenin and the Zyryanovsk Lead Combine imeni 60-letiya SSSR.

69. D. F. Baldenko, N. P. Bezlepkin, T. N. Bikchurin, Yu. V. Vadetskiy, M. T. Gusman, Yu. V. Zakharov, A. M. Kochnev, S. S. Nikomarov, A. V. Perov, R. Kh. Fatkullin, A. V. Tsepkov. "The Development and Introduction in Industry of Downhole Helical Multistart Motors for the Drilling and Repair of Oil and Gas Wells."

Submitted by the Ministry of the Petroleum Industry.

70. M. I. Berezinets, S. D. Viktorov, G. P. Demidyuk, A. A. Yegupov, V. A. Kovalev, Ye. A. Kompaneytsev, A. A. Menshov, V. I. Polityuk, V. I. Samoylov, V. F. Ushakov, V. M. Fidel. "The Development and Introduction of the Equipment and Technology of the Working of Frozen Placers With the Use of Explosives Which Are Produced at the Site."

Submitted by the USSR Ministry of Nonferrous Metallurgy.

71. R. A. Veselovskiy, K. A. Zabela, Yu. K. Znachkov, Yu. S. Lipatov, T. E. Lipatova, N. D. Trifonov, Ye. I. Fedorchenko, V. D. Chernyayev, Zh. I. Shanayev, A. N. Shilakin. "The Development and Introduction of a New Technology of the Reconditioning of Oil Tanks, Underwater Pipelines and Other Equipment on the Basis of Special Composite Polymeric Materials."

Submitted by the Ministry of the Petroleum Industry.

72. A. N. Dmitriyevskiy, O. K. Angelopulo, V. D. Gorodnov, S. N. Zakirov, Yu. P. Korotayev, L. K. Mukhin, M. B. Rapoport, V. I. Shraybman, G. G. Balayan, N. I. Komkov. "The Development and Introduction of Scientific and Technical Decisions, Which Ensure the Increase of the Effectiveness of the Search for, Prospecting and Development of Petroleum and Gas Deposits Under Difficult Geological Mining Conditions."

Submitted by the USSR Ministry of Higher and Secondary Specialized Education.

73. N. A. Drizhd, B. F. Negrutskiy, P. M. Trukhin, V. M. Kuptsov, M. R. Imankulov, P. G. Nebykov. "The Development and Introduction of an Advanced Technology and Organization of Mine Erection Work in Shafts."

Submitted by the USSR Ministry of the Coal Industry.

74. A. G. Laptev, V. A. Lipkovich, I. V. Popenko, I. I. Tamarin, V. T. Gershun, A. A. Chichkan, Ye. P. Zakharov, V. D. Kalmykov, V. M. Pichkovskiy, V. I. Rovitskiy, V. I. Selinnyy. "The Development, Assimilation of the Series

Production and Introduction of the Highly Productive Strela-68 and Strela-77 Machines for the Unmanned Making of Entries Through Rocks."
Submitted by the USSR Ministry of the Coal Industry.

75. V. A. Bykov, N. F. Gritsuk, V. S. Gubert, A. S. Gusev, K. S. Drozdetskaya, G. A. Zykov, Ya. A. Kaplun, V. F. Ovchinnikov, B. Ya. Orlov, V. I. Popelnukh, D. P. Sychev. "The Development and Introduction of an Advanced Technology of Highly Productive Automated Equipment for the Production of a Wide Assortment of Economical I-Beams With Parallel Faces of the Flanges."

Submitted by the Nizhniy Tagil Metallurgical Combine imeni V. I. Lenin.

76. V. K. Vitryanyuk, A. V. Derzhavin, G. T. Dzodziyev, A. A. Kalkov, V. D. Lyubimov, B. V. Mitrofanov, I. A. Ordinartsev, D. I. Pelts, Ye. K. Plaksin, V. S. Samoylov, V. I. Tretyakov, G. P. Shveykin. "The Development, Industrial Assimilation and Introduction in the National Economy of New Efficient Hard Alloys Which Do Not Contain Tungsten and Cobalt."

Submitted by the USSR Ministry of Nonferrous Metallurgy, the Ural Scientific Center of the USSR Academy of Sciences and the All-Union Council of Scientific and Technical Societies.

77. V. M. Kudinov, I. M. Aranovskiy, V. I. Artemyev, V. N. Glukhovskiy, B. G. Zlokazov, A. D. Kapitonov, A. N. Pashchin, V. G. Petushkov, V. S. Smirnov, V. I. Trufyakov. "The Formulation of the Scientific Principles, the Development and Extensive Introduction of a New Technology of the Explosion Machining of the Welded Joints of Large-Sized Equipment and Metal Components."

Submitted by the All-Union Scientific Research and Design Institute of the Aluminum, Magnesium and Electrode Industry.

78. S. N. Suturin, Yu. S. Arzamastsev, A. V. Dolgov, V. Ye. Dyakov, V. S. Yelyutin, A. A. Klevakin, Yu. S. Koryukov, G. I. Orlov, I. M. Selivanov, A. Ye. Semenov, N. G. Sizykh, G. I. Stepanov. "The Development and Introduction of Highly Efficient Equipment and Technology of the Complete Processing of Stanniferous Raw Materials With the Output of High Quality Products and the Decrease of Environmental Pollution."

Submitted by the Novosibirsk Tin Combine.

79. S. T. Takezhanov, B. M. Alibayev, T. Sh. Bayanzhanov, G. P. Giganov, A. S. Kulenov, V. A. Nasyrov, G. L. Pashkov, V. V. Sergiyevskiy, N. P. Tolstoukhov, A. I. Kholkin, G. A. Yagodin. "The Development and Introduction of Highly Efficient Extraction Processes, Which Ensure the Increase of the Completeness of the Use of Polymetallic Raw Materials and the Establishment at the Ust-Kamenogorsk Lead and Zinc Combine imeni V. I. Lenin of the Modern Production of Rare Metals."

Submitted by the USSR Ministry of Nonferrous Metallurgy and the Krasnoyarsk Affiliate of the Siberian Department of the USSR Academy of Sciences.

80. P. K. Teterin. "Teoriya periodicheskoy prokatki" [The Theory of Batch Rolling], "Teoriya poperechnoy i vintovoy prokatki" [The Theory of Cross and Screw Rolling]. (Monographs, Moscow, "Metallurgiya", 1978, 1983.)

Submitted by the Central Scientific Research Institute of Ferrous Metallurgy imeni I. P. Bardin.

81. S. K. Arakelyan, A. Ya. Yermolin, N. N. Zheludkov, M. A. Kamyshev, Yu. T. Kenegesov, A. N. Kolotilin, V. G. Pelipenko, G. P. Pischasov, S. I. Stanevich, A. M. Sushkin, Ye. N. Yakovlev. "The Designing and Construction of Highly Reliable Underwater Crossings of Transcontinental Gas Pipelines on the Basis of the Example of the Urengoy-Pomary-Uzhgorod Gas Pipeline."

Submitted by the Ministry of Construction of Petroleum and Gas Industry Enterprises and the Ministry of the Gas Industry.

82. A. S. Boldyrev, S. M. Medin, Ye. N. Leontyev, Yu. I. Draychik, A. V. Shatokhin, Ye. I. Gedima, V. N. Goncharik, L. B. Belenkiy, M. S. Rusina, Yu. V. Gern, A. M. Telesh, Kh. S. Vorobyev. "The Elaboration of the Technology and the Development of Automated Conveyor Lines for the Production of Large-Sized Items Made of Dense Lime (Cementless) Concrete."

Submitted by the USSR Ministry of the Construction Materials Industry.

83. A. P. Morozov, O. A. Kurbatov, Yu. A. Yeliseyev, G. G. Zedginidze, Ye. N. Mitrofanov, Ye. P. Lavrov, I. I. Ponomarev, V. M. Krasnov, V. G. Sergeyev, Ye. V. Toropov. "The Study, Development and Introduction of a Large-Span Membrane Roof 160 m in Diameter for the Sports and Concert Complex imeni V. I. Lenin in Leningrad."

Submitted to the State Committee for Civil Construction and Architecture attached to the USSR State Committee for Construction Affairs and the USSR Ministry of Installation and Special Construction Work.

84. A. M. Storozhinskiy, V. I. Andrianov, V. T. Antonov, V. A. Bayev, V. G. Batrakov, Ye. D. Belousov, K. P. Grinevich, A. A. Zhdanov, V. V. Severnyy, N. G. Ufimtsev, A. T. Kholodkov, O. S. Shiryayev. "The Development of the Scientific Principles of the Technology, the Organization of the Industrial Production and the Mass Introduction in Construction of a Set of Organosilicon Composite Materials."

Submitted by NIIMosstroy of the Main Administration for Housing and Civil Construction of the Moscow City Soviet Executive Committee and the State Scientific Research Institute of the Chemistry and Technology of Organoelemental Compounds.

Textbooks for Higher Educational Institutions

1. N. S. Akhmetov. "Obshchaya i neorganicheskaya khimiya" [General and Inorganic Chemistry] (Moscow, "Vysshaya shkola", 1981).

2. I. P. Bazarov. "Termodinamika" [Thermodynamics] (3rd edition, Moscow, "Vysshaya shkola", 1983).

3. B. N. Begunov, N. P. Zakaznov, S. I. Kiryushin, V. I. Kuzichev. "Teoriya opticheskikh sistem" [The Theory of Optical Systems] (2nd edition, Moscow, "Mashinostroyeniye", 1981).

4. A. P. Vasilyev, V. M. Kudryavtsev, V. A. Kuznetsov, V. D. Kurpatenkov, A. M. Obelnitskiy, V. M. Polyayev. "Osnovy teorii i rascheta zhidkostnykh raketnykh dvigateley" [The Fundamentals of the Theory and Design of Liquid-Propellant Rocket Engines] (3rd edition, Moscow, "Vysshaya shkola", 1983).

5. I. M. Grushko, I. V. Korolev, I. M. Borshch, G. M. Mishchenko. "Dorozhno-stroitelnyye materialy" [Road Construction Materials] (Moscow, "Transport", 1983).

6. G. G. Yermolayev. "Morskaya lotsiya" [Maritime Sailing Directions] (4th edition, Moscow, "Transport", 1982).

7. P. I. Polukhin, N. M. Fedosov, A. A. Korolev, Yu. M. Matveyev. "Prokatnoye proizvodstvo" [Rolling] (3rd edition, Moscow, "Metallurgiya", 1982).

Submitted by the USSR Ministry of Higher and Secondary Specialized Education.

Textbooks for Secondary Specialized Educational Institutions

8. B. V. Krasov. "Remont i montazh oborudovaniya predpriyatiy molochnoy promyshlennosti" [The Repair and Installation of Equipment of Dairy Industry Enterprises] (2nd edition, Moscow, "Legkaya i pishchevaya promyshlennost", 1982).

9. V. V. Mayskiy, V. K. Muratov. "Farmakologiya s retsepturoy" [Pharmacology With Prescription Filling] (2nd edition, Moscow, "Meditsina", 1980).

10. Yu. V. Yakubovskiy, L. L. Lyakhov. "Elektrorazvedka" [Electric Geophysical Exploration] (4th edition, Moscow, "Nedra", 1982).

Submitted by the USSR Ministry of Higher and Secondary Specialized Education.

A Textbook for Secondary School

11. V. A. Kovalev, V. V. Buznik, A. S. Bushmin, P. S. Vykhodtsev, N. A. Groznova, L. F. Yershov, G. N. Ionin, K. D. Muratova, A. I. Pavlovskiy, V. V. Timofeyeva, A. I. Khvatov, V. A. Shoshin. "Russkaya sovetskaya literatura, X klass" [Russian Soviet Literature, the 10th Grade] (8th edition, "Prosveshcheniye", 1983).

Submitted by the USSR Ministry of Education.

A Textbook for Vocational and Technical Educational Institutions

12. M. N. Bogdanov. "Uchebnaya kniga operatora-ptitsevoda (proizvodstvo yayts)" [Textbook of the Operator-Poultry Raiser (Egg Production)] (3rd edition, Moscow, "Kolos", 1981).

Submitted by the USSR State Committee for Vocational and Technical Education.

In publishing the list of 84 works and 12 textbooks, which have been allowed to take part in the competition, the Committee appeals to the executives of scientific and scientific and technical societies, scientific institutions, enterprises and educational institutions to hold public discussions of the works and their collectives of authors.

All criticisms, the materials of the discussions and the remarks on the works and the collectives of authors should be sent to the Committee no later than 15 August of this year at the address: 125047, Moscow A-47, Third Tverskaya-Yamskaya Ulitsa, House 46.

Telephone numbers: 250-38-08, 250-19-47, 250-37-14.

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AWARDS AND PRIZES

NOMINATIONS FOR LITHUANIAN SSR STATE PRIZES IN SCIENCE, TECHNOLOGY

Vilnius SOVETSKAYA LITVA in Russian 17 Apr 85 p 3

[Article: "In the Committee for Lithuanian SSR State Prizes in Science and Technology Attached to the Lithuanian SSR Council of Ministers. A List of the Works and Their Authors, Which Have Been Submitted for the Awarding of Prizes in 1985"]

[Excerpt] Precision Sciences

1. The series of works "Microwave Studies of the Dynamics of Ferroelectrics and Materials Related to Them and Their Use in Ultra-High Frequency Equipment" (1967-1984)--Y. Grigas.

2. The series of works "Nonequilibrium Collective Phenomena in Semiconductors" (1974-1984)--R. Baltrameyunas, V. Bareykis, A. Reklaytis.

3. The series of works "Studies of Controlled Markovian Processes and Fields" (1969-1984)--G. Pragarauskas, D. Surgaylis.

Technical Sciences

1. "The Development and Introduction of a Mechanized Flow Line of the Production of Dry Potato Puree in the Form of Granules at the Taurage Fruit and Vegetable Combine of the Lithuanian SSR Ministry of the Fruit and Vegetable Industry"--Yu. Vidmantas, I. Zabashtanskiy, V. Zaletskiy, P. Ivanauskas, A. Mazur, V. Povilayka, M. Raginya, I. Tamulis, V. Chereshkyavichyus.

2. "The Development and Introduction of Methods and Means of the Computer-Aided Designing of Modern Radio Measuring Equipment" (1974-1984)--S. Balchyunas, V. German, E. Gudelyavichyus, G. Zhintelis, P. Kanapyatskas, E. Karchyauskas, V. Lapidus, K. Ryakyavichyus, V. Starikov.

3. "The Development and Introduction in Production of the Technology of Majolica, Stone Body and Bone China on the Basis of Local Quartz and Aluminosilicate Raw Materials at the Yesya Experimental Plant of Art Ceramics"--A.-V. Byankunskene, G. Vayshvilene, R. Gyanis, I.-Yu. Lamauskayte,

F. Savitskas, K. Sadzyavichyus, L. Timleris, A. Sheryalene, V. Yasyukyavichyus.

4. The series of works "The Study of the Laws, the Formulation and Introduction of Methods of the Calculation of the Resistance of Materials and Components to a Low Cyclic Load" (1960-1984)--M. Daunis, G. Maydyakshas.

5. The series of works "The Optimization of the Main and City Distribution Networks and the Efficient Use of Gaseous Fuel" (1970-1984)--A. Garlyauskas, R.-A. Lyaukonis.

6. The textbook "Osnovy teorii tsepey" [The Fundamentals of Circuit Theory] (Vilnius, "Mokslas", 1980)--A. Yochis, R. Krivitskas.

Agricultural and Natural Sciences

1. The series of works "The Study and Large-Scale Mapping of the Soils of the Lithuanian SSR" (1951-1984)--B. Bleyzgis, A. Botirene, M. Vaychis, Y.-P. Kyanstavichyus, V. Melisyakas, A.-Yu. Rutkauskas, V. Skuodzhyunas, Yu. Yuodis, A. Yuozakas.

2. The series of works "Complexes of Soil Invertebrates and Their Influence on the Fertility and Biological Activity of the Soil" (1957-1984)--O. Atlavinite, I. Eytminavichyute.

3. The series of works "The Achievements of the Diagnosis and Surgical Treatment of Diseases of Vessels at Vilnius State University imeni V. Kapsukas During the Period of 1963-1983"--E.-V. Barkauskas, A. Grishkyavichyus, G.-A.-K. Dirse, A. Dranenko, E. Kosinskas, A. Martsinkyavichyus, P. Paulyukas, D. Triponene, V.-I. Triponis.

4. The textbook "Mikrobiologiya" [Microbiology] (Vilnius, "Mokslas", 1983)--Yu. Pechyulis.

Economic Sciences and Humanities

1. The series of works "The System of the Preparation of Efficient Comprehensive Sectorial Plants: The Methodology and Mathematical Economic Models" (1973-1984)--K. Antanavichyus.

2. The monographs: "Yazyk. Logika. Filosofiya (analiz sovremennykh logiko-filosofskikh kontseptsiy yazyka)" [Language. Logic. Philosophy (The Analysis of Current Logical Philosophical Concepts of Language)] (Vilnius, "Mintis", 1981), "Problema smysla" [The Problem of Meaning] (Moscow, "Mysl", 1983)--R. Pavilenis.

3. The development and organization of the mass introduction of the automated system of the conducting of insurance operations of the inspectorates of state insurance with the use of computer technology (ASVSO)--T. Venkina, D. Visotskene, I. Gaylyus, S. Kovalskaya, D. Motekaytene, K. Purvinskas, M. Rodionova.

4. "Litovskaya sovetskaya entsiklopediya" [Lithuanian Soviet Encyclopedia] (Volumes I-XII, Vilnius, 1976-1984)--V. Vaychekauskas, L. Valyus, Y. Zinkus, V. Kvetkauskas, B. Kurkulis, M. Pozharskas, A. Trakimas.

Construction and Architecture

1. "The Improvement of the Theory of Urban Transport and Its Introduction in the Lithuanian SSR" (1967-1984)--V.-V. Sheshtokas (posthumously).

2. "The Memorial Complex to Soviet Soldiers and Partisans at the Vilnius Antakalnis Cemetery"--R.-D. Dichyus (director of the work), Yu. Burneyka, S. Vaychaytite, D. Varyakois, A. Grazhis, N. Duda, K.-V. Kachonas, A. Palileyka, Ya. Shiktorov.

3. "Author's, Designing and Executive Activity During the Designing and Equipment of New and Renovated Stores, Public Dining Enterprises, as Well as Drugstores in theCity of Kaunas" (1976-1984)--I. Matsyulyavichyus.

4. "The Kaunas Merkuriyus Department Store (Architecture, Construction, the Technology of Trade, the Interior, the Scientific Organization of Labor)"--A. Dvaryatskas, A. Kazlauskas, N. Mikolaytene, P. Mitskuans, Ch. Navitskas, R. Pakalnishkis, A.-A. Sprindis, V. Urmonene, Yu. Utars.

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SCIENTIFIC LIFE

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GENERAL

PURIN SPEECH ON ACTIVITY OF LATVIAN ACADEMY OF SCIENCES

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR in Russian No 3, Mar 85 pp 3-8

[Speech by President of the Latvian SSR Academy of Sciences B. A. Purin at the 15 November 1984 meeting of the Presidium of the USSR Academy of Sciences: "On the Scientific Activity of the Latvian SSR Academy of Sciences"]

[Text] From 28 May to 1 June 1984 the Commission of Scientists of the USSR Academy of Sciences familiarized itself with the scientific activity of the Latvian SSR Academy of Sciences. The results of the activity of the commission were discussed at an expanded meeting of the Presidium of the Latvian SSR Academy of Sciences on 31 May 1984.

On 15 November 1984 the Presidium of the USSR Academy of Sciences heard and discussed the reports of President of the Latvian SSR Academy of Sciences B. A. Purin and Chairman of the Commission of Scientists of the USSR Academy of Sciences Academician N. M. Emanuel. Secretary of the Latvian CP Central Committee I. A. Anderson, Deputy Chairman of the Latvian SSR Council of Ministers V. M. Krumin, as well as a number of members of the Presidium of the Latvian SSR Academy of Sciences took part in the meeting. Academicians M. M. Shults, N. M. Zhavoronkov, Yu. A. Ovchinnikov, G. K. Skryabin and A. A. Bayev and Corresponding Member of the USSR Academy of Sciences V. V. Bolotin took part in held discussion. President of the USSR Academy of Sciences A. P. Aleksandrov summarized the discussion.

The Presidium of the USSR Academy of Sciences adopted the decree "On the Work of the Scientific Institutions of the Latvian SSR Academy of Sciences in the Area of the Development of New Materials, Biotechnologies and Medical Preparations and the Automation of Scientific Research," in which a description of the work of the Latvian SSR Academy of Sciences was given. The Presidium of the USSR Academy of Sciences approved of the scientific activity of the Latvian SSR Academy of Sciences and specially pointed out the

establishment and development at the academy of efficient complexes of research and development of new materials with high parameters, diverse biotechnology for the solution of the problems of the USSR Food Program, a wide range of medical preparations, apparatus and systems for the monitoring and control of production processes and the scientific experiment.

At the same time a number of shortcomings were noted in the adopted decree of the Presidium of the USSR Academy of Sciences. The Latvian SSR Academy of Sciences is inadequately coordinating scientific research in the republic. The experimental base of the academy is not undergoing proper development. Attention was directed to the need to step up the work of the institutes of the Latvian SSR Academy of Sciences on the preparation of suggestions on the large-scale use in the national economy of the results of completed research and development.

In the Latvian SSR there are more than 60 scientific institutions, planning and technological design organizations, including the institutes of the Academy of Sciences, 10 higher educational institutions, a number of sectorial organizations of union subordination and organizations of republic subordination. About 13,000 scientific associates alone (including 340 doctors of sciences and 4,500 candidates of sciences) work in these organizations.

The Academy of Sciences unites 15 institutes, 5 technological design bureaus and 4 experimental plants. In all 1,650 scientific associates (13 percent of the total number in the republic) work at the academy, of them 107 are doctors of sciences (30 percent) and 904 are candidates of sciences (20 percent). The total number of people working at the academy is about 7,700.

Thus, as a whole in the republic a large scientific and technical potential has been created. However, it is being used inadequately for the acceleration of scientific and technical progress.

The coordination of all scientific research work in the area of the natural, technical and social sciences in the republic has been assigned to the Academy of Sciences, but the academy is not carrying out this work actively enough, especially with respect to sectorial scientific research organizations.

The Commission of Scientists of the USSR Academy of Sciences noted that the Latvian SSR Academy of Sciences, in fulfilling the decisions of the 26th CPSU Congress and the subsequent CPSU Central Committee plenums on the development of science and the acceleration of scientific and technical progress, with the constant assistance of the Latvian CP Central Committee, the Latvian SSR Council of Ministers and the USSR Academy of Sciences achieved leading positions in a number of directions of basic and applied research, such as the magnetohydrodynamics of incompressible media, the mechanics of rigid bodies and polymers, multiple-machine computer systems and networks, the plasma chemistry of inorganic compounds, the synthesis and search for physiologically

active substances on the basis of research in the area of biochemistry, organic chemistry and molecular biology, the chemistry of wood and its basic components, the microbic synthesis of biologically active substances and the improvement of the economic mechanism of the agroindustrial complex.

In these and other most important directions of modern science scientific schools, which have received recognition in the country and abroad, have been formed; five all-union scientific journals are published; four all-union scientific councils are working on the basis of the Latvian SSR Academy of Sciences, all-union conferences are traditionally held regularly. The most important works of scientists of the academy have been awarded USSR and republic state prizes and prizes of the USSR Council of Ministers. Institutions of the Latvian SSR Academy of Sciences in 1979-1983 in the All-Union Socialist Competition of the USSR Academy of Sciences and the Academies of Sciences of the Union Republics four times took first places and were awarded the Challenge Red Banner. The Institute of Organic Synthesis in 1982 was awarded the Challenge Red Banner of the CPSU Central Committee, the USSR Council of Ministers, the All-Union Central Council of Trade Unions and the All-Union Komsomol Central Committee.

Of the results of scientific research work, which are of great scientific and practical importance, it is possible to note the following ones.

In the area of magnetohydrodynamics two-dimensional magnetohydrodynamic turbulence was demonstrated experimentally for the first time, a method of predicting the conditions of the transition to self-excitation of a magnetic field in flows of molten metal was developed, a new class of magnetostatic instabilities in magnetizable fluids was predicted theoretically and was identified experimentally, a thermodynamic model of the stability of magnetic fluids was developed.

In the area of the mechanics of rigid bodies and polymers the theoretical principles of the reinforcement, filling, deformation and destruction of polymers and composites, the development of methods and means of the nondestructive study of their properties and the prediction of their long-term resistance were elaborated, physical methods of the intensification of the production of polymers and composites and practical suggestions for the acceleration of the development of new composites with a given set of properties for new equipment were elaborated.

In the area of semiconductor physics the physical principles of electronic processes in organic molecular crystals were elaborated.

In the area of inorganic chemistry the physical chemical principles of the plasma chemistry processes of the synthesis of compounds and methods of obtaining refractory compounds in the form of ultradispersed powders were elaborated.

Significant gains were made in the area of the synthesis of new physiologically active compounds. The synthesis of derivatives of new heterocyclic systems, hetero-organic derivatives of furans, hetarylsilanes, prostaglandins and analogues of neuroactive, immunoactive and vasoactive

peptides was accomplished. The complete structure of the DNA of the cloned genome of the hepatitis B virus was determined. Bacterial producers of a new type of human leucocyte interferon and antigens of the hepatitis B virus were developed. Substantial gains were made in the study of the interrelationship of a virus and a cell by genetic engineering methods and in the development of methods of the diagnosis and immunoprophylaxis of cattle leucosis.

In the area of the microbic synthesis of biologically active substances the strains of producers of L-lysine and citric acid were improved, the possibilities of using new types of raw materials for biotechnological processing were established.

In the area of wood chemistry the theory of the structure of wood material made of fibrillar cellulose reinforcement, which is embedded in a lignin-hemicellulose matrix, was elaborated. The theory explains many properties of wood, of its conversion during the production of pulp and of the chemical modification of wood.

In the area of multiple-machine computer systems and networks the experimental computer network of the Latvian SSR Academy of Sciences was set up and continues to be improved, the architecture of computer networks, including the Akademset (the computer network of the USSR Academy of Sciences and the academies of sciences of the union republics), is being elaborated. There were elaborated: the general concept of the use of the Unified System of Electronic Computers and the International System of Small Computers in open computer networks for the CEMA countries; the concept of the establishment of local computer networks.

The designing of the Priznak system for automated searching, the selection of attributes and the prediction of the biological activity of chemical compounds was completed (the Institute of Organic Synthesis). Subsystems of the automation of studies of the strength characteristics of composite polymeric materials were established (the Institute of Polymer Mechanics).

In 3 years of the 11th Five-Year Plan more than 400 developments of the academy were introduced in the national economy of the country, including 197 in the republic. In all 14 license (foreign trade) agreements were concluded and implemented.

It is interesting to note that the bulk of the license currency receipts in 3 years of the 11th Five-Year Plan in the republic were obtained in accordance with developments of the Latvian SSR Academy of Sciences.

I will cite several examples of the introduction of developments of the academy in the national economy of the country and republic. Thus, owing to the implementation of developments of the Institute of Microbiology the output of lysine at the Livany Pilot Biological Plant exceeded by 2.5-fold the rated capacity. Five plants of the country are operating in accordance with this technology.

All the plants of the country, which produce citric acid, are operating in accordance with the biotechnology of obtaining citric acid, which was

developed at the Experimental Plant of Biochemical Preparations of the Institute of Microbiology. In accordance with this technology the yield of the final production is 20-30 percent greater than in case of the use of the best foreign technologies. Seven license agreements for its use have been concluded.

The construction of the Zilayskalns Pilot Industrial Plant (Valmiyerskiy Rayon) for the production of fodder yeast and molasses from slightly rotten peat in accordance with the technology, which was developed at the Institute of Wood Chemistry, is being completed.

An efficient technology of obtaining furfurol from deciduous wood, which makes it possible to increase the yield of furfurol by 20-25 percent as compared with the world level, was developed by the Institute of Wood Chemistry and has been introduced at a number of enterprises of the country. A license for it was sold to one of the Yugoslav firms.

In the Soviet Union in 1981-1983 products in the amount of about 150 million rubles were produced in accordance with developments of the Institute of Organic Synthesis. The majority of products, which are put out by the plants of the Olaynfarm and Biokhimreatkiv associations (the Latvian SSR), are produced in accordance with developments of the Institute of Organic Synthesis. Significant currency receipts were obtained from the export of medical preparations.

In the area of the development of new materials the research and development of the Institute of Polymer Mechanics, which during 1981-1983 introduced 57 developments with a total economic impact of 13 million rubles, are topical and highly effective.

The Institute of Inorganic Chemistry introduced a plasma technology of obtaining new refractory compounds in the form of ultradispersed powders, which is being used in the tool and other sectors of industry, as well as when developing materials of new equipment. In the Latvian SSR sections for the repair of parts of agricultural, road and construction machinery by the method of plasma spraying have been set up in the system of the State Committee for the Supply of Production Equipment for Agriculture and the Ministry of Construction. New methods of protecting metals against corrosion, which are being successfully introduced in various sectors of the national economy, including for the protection of agricultural objects against corrosion, have been developed.

The Institute of Physics introduced magnetohydrodynamic stirring units at the Bratsk Aluminum Plant. Their introduction at other plants has begun. The anticipated impact for the sector will come to about 10 million rubles.

The Institute of Physics and Power Engineering jointly with the Alfa Production Association (Riga), the Tallinn Electrical Equipment Plant and other plants implemented an extensive program of the introduction of new methods of the technology and control of the production of semiconductor instruments and circuits; with a department of the All-Union Scientific Research Institute of Electric Welding Equipment (Vilnius) it developed and

assimilated the large-series production of welding units with rectifier inductor generators; the national economic impact comes to 20 million rubles a year.

The design and pilot industrial base of the academy, which consists of five design bureaus and four experimental plants, is playing an important role in the increase of the efficiency of the activity of the institutes and the acceleration of the use of completed scientific research in the national economy. Each of these institutions together with an academic institute forms a unified scientific and technical complex.

The goal program principle is being used more and more extensively in planning practice.

At present the Latvian SSR Academy of Sciences is taking part in the fulfillment of 30 comprehensive programs of union importance, including 13 goal programs and 17 programs on the solution of scientific and technical problems, and is making a significant contribution to the fulfillment of 16 republic programs.

Serious tasks face the academy. Of course, it is necessary also to develop further at a high theoretical level the basic research on the basic scientific directions, which were specified for the republic academy by the Presidium of the USSR Academy of Sciences. However, applied research should make a more significant contribution to the acceleration of scientific and technical progress in the country, moreover, it is necessary to increase the proportion of the introduction of the achievements of science in the national economy of the republic.

For the accomplishment of these tasks the academy needs to continue the concentration of scientific forces and material and technical supply on the rapid development of large scientific research and pilot industrial complexes, which have already been formed or are being organized at present:

--the development of new medical preparations and agents for agriculture (the Institute of Organic Synthesis, the Institute of Microbiology, the Institute of Biology, higher educational institutions, sectorial institutes, the pilot plants of the academy, the Biokhimreaktiv and Olaynfarm scientific production associations);

--the development of biotechnological processes (the Institute of Microbiology, the Institute of Organic Synthesis, the Institute of Wood Chemistry, the Institute of Biology, higher educational institutions, sectorial institutes, the pilot plants of the academy, the fodder production complex at the Uzvara Kolkhoz (Bauskiy Rayon), the experimental biotechnical complex of the Ogre Sovkhoz);

--the complete processing of wood (the Institute of Wood Chemistry, the Special Design and Technological Bureau of Wood Chemistry, the Silava Scientific Production Association);

--the development of new materials (the Institute of Polymer Mechanics, the Institute of Inorganic Chemistry, the Institute of Physics, the Institute of Physics and Power Engineering, higher educational institutions, sectorial institutes, special design and technological bureaus with pilot works);

--the protection of metals against corrosion (the Institute of Inorganic Chemistry, the Antikor Special Design and Technological Bureau, the Baltic Corrosion Station, sectorial scientific research and planning and design organizations);

--automation and the extensive use of computer technology (the Institute of Electronics and Computer Technology, the institutes of the Latvian SSR Academy of Sciences, the Scientific Research Institute of Planning attached to the State Planning Committee, higher educational institutions, the Ministry of Communications).

Great tasks face the established Center of Robotics, the activity of which for the present still cannot be considered satisfactory.

The successful performance of these operations will make a significant contribution to the fulfillment of the Food and Energy Programs.

It is necessary to strengthen the coordination of scientific research work with higher educational institutions and especially with sectorial institutes.

The Scientific Council for Problems of Technical and Socioeconomic Forecasting of the Latvian SSR State Planning Committee and the Latvian SSR Academy of Sciences (with problem commissions) has been organized in the republic. The Council for the Coordination of Scientific Activity in the Area of the Natural and Social Sciences and the Council for Relations of the Academy of Sciences With the Higher School exist under the Presidium of the Latvian SSR Academy of Sciences, a large number of problem councils are working under it. It is necessary to increase their role in the coordination of scientific research work. The republic State Planning Committee jointly with ministries, departments and scientific research organizations needs to formulate effective republic goal programs for the 12th Five-Year Plan. However, the coordination of scientific research and pilot industrial operations in the republic is being complicated by the fact that the academy, higher educational institutions and sectorial institutes are subordinate to different departments, the enterprises, scientific production associations, scientific research and planning and design organizations of union subordination have a large proportion in the republic.

The question of strengthening the experimental base is especially urgent for the academy. The majority of institutes have modern laboratory buildings. A good deal of assets has been invested during the years of existence of the academy. However, it is necessary to complete the construction of a number of new laboratory buildings and especially to renovate the pilot industrial base of the academy.

During the 10th Five-Year Plan 57 percent of the planned amount of contracting construction work was assimilated. During the 11th Five-Year Plan in 3 years (1981-1983) only 42 percent was assimilated. In 1984 the situation improved somewhat. However, the question of the construction of the experimental base of the academy remains one of the sorest ones. Due to the unsatisfactory fulfillment of the plan of capital construction by the republic Ministry of Construction during preceding years of the five-year plan the construction of a number of new projects was postponed.

Such scientific research as robotics and magnetohydrodynamics (the Institute of Physics), scientific instrument making (the Institute of Polymer Mechanics), semiconductor technologies (the Institute of Physics and Power Engineering), computer networks (the Institute of Electronics and Computer Technology), the obtaining of ultradispersed powders of refractory compounds and new materials and the protection of metals against corrosion (the Institute of Inorganic Chemistry), is being unsatisfactorily supplied with pilot bases.

The majority of experimental sections of the existing special design and technological bureaus are scattered about the city and are located in buildings which are unsuited for the performance of work. The construction for each special design and technological bureau of a modern experimental base could drag on to the year 2000. The realistic evaluation of the formed situation leads to the conclusion of the expedience to unite the five special design bureaus of the institutes of the Physical and Technical Sciences Department into one modern pilot plant (arbitrarily "Instrument Making and Robotics") with the assurance of its construction during the 12th Five-Year Plan and its provision with modern equipment. It is necessary to realize the achievements of scientific and technical progress first of all at the academy itself.

The republic State Planning Committee, Ministry of Construction and Academy of Sciences need to coordinate the amounts of capital construction of science facilities (and they are very large during the 12th Five-Year Plan) and to ensure the fulfillment in the future of the plan of capital construction.

The question of the more complete filling of the orders of the Latvian SSR Academy of Sciences for the supply of technological equipment, instruments and limited materials, including imported ones, should be examined; the deliveries of microcomputers and additional peripheral equipment of computers should be improved substantially.

I would like once again to briefly formulate the means of accomplishing the tasks which have been set for the academy: the concentration and coordination of scientific research, participation in the fulfillment of comprehensive programs and the strengthening of the experimental base.

In conclusion allow me to assure the Presidium of the USSR Academy of Sciences that the scientists of the Latvian SSR Academy of Sciences will exert every effort for the fulfillment of the tasks, which were posed by the 26th CPSU

Congress and the subsequent CPSU Central Committee plenums, and the decisions of the party and government on science and the acceleration of scientific and technical progress.

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GENERAL

INDICATORS FOR MEASURING SCIENTIFIC, TECHNICAL PROGRESS

Moscow EKONOMIKA I MATEMATICHESKIYE METODY in Russian No 2, Mar-Apr 85 (manuscript received 12 Jul 84) pp 324-332

[Article by G. A. Lakhtin (Moscow): "On the Choice of a Measurer of Scientific and Technical Progress"]

[Text] The task of accelerating scientific and technical progress (NTP), which has been placed by the Communist Party at the center of economic policy, requires the improvement of its management, which is impossible without measurers which objectively reflect the results of the regulated process. The corresponding indicators are necessary for the comparison of the actual state with the desired or prescribed (planned) state and for the identification of deviations which serve as the starting points for control actions. So that this would be feasible, the states in question should have characteristics: desirable--quantitative, mandatory--comparable. For the solution of this problem it is necessary to answer the questions: What is to be measured and by what (or how)?

By scientific and technical progress there is understood the process of improving production on the basis of the use of the achievements of science and technology. In this process two directions can be distinguished: the improvement of production itself (its technology, organization, the equipment being used) and of the product. In real life they are interwoven; for example, the changeover to the output of a new product can entail the updating of the technology, which, however, does to eliminate their fundamental differences and does not prevent them from being examined separately.

Two types of results correspond to these actions:

--the improvement of production leads to a decrease of the costs, that is, yields an impact at the introducing enterprise; if only the technology changes, the saving is also the result, which is final and is liable to measurement; the consumer obtains the former product at the former price, this innovation does not affect him;

--if a product is improved, the change of its parameters (the appearance of new properties or the improvement of former ones) acts as the immediate result. The set of these changes signifies an increase of the technical

level, which it is customary to compare with the world level, domestic level and so forth.[1] But this process is not an end in itself and the useful effect of the introduced innovation is not confined to this. A product of a higher level should yield an impact (in the simplest case a saving on operating expenses) to whoever uses it. Whereas the noted increase acts as a direct result of scientific and technical progress, the impact for the user acts as a mediated result.

Thus, in principle the following means of measuring scientific and technical progress are possible: in case of the improvement of production--in terms of the economic impact in the introducing unit; in case of the improvement of a product--either in terms of the technical level in this unit or in terms of the economic impact for the user.

At present the latter direction of the introduction of the achievements of science and technology predominates. The statistics of invention can serve as evidence of this, since 93 percent of the inventions are developed at scientific research institutes, design bureaus and other organizations within the framework of planned work [1, p 3]. The analysis of the official bulletins OTKRYTIYA. IZOBRETENIYA, which are published by "Poisk", VNIIPI Scientific Production Association of the USSR State Committee for Inventions and Discoveries, shows that about 75 percent of the inventions in our country are assigned to the class of devices, methods account for 21 percent and substances account for 4 percent. Thus, the improvement of products, and not technology, is the dominant direction of scientific and technical progress. The basic difficulties in the measurement of scientific and technical progress also pertain precisely to it.

In the works devoted to the management of scientific and technical progress the problem of measuring attainable progress boils down to how to evaluate the economic impact of the implementation of a specific scientific and technical measure or invention. It is thereby vaguely assumed that it serves as the only gauge and it is only a matter of choosing the best method of calculation. However, the question: For what do we calculate the economic impact and is it the best or even the only possible indicator for the making of the decisions, from which the management of scientific and technical progress is formed? is pertinent.

In the methods and scientific works the choice between several versions of a scientific and technical measure is advanced as the basic task, for the sake of the accomplishment of which the impact is calculated. Consequently, it is assumed that there are several competing developments, which were conducted in parallel and were completed simultaneously and the results of which must be compared economically for the choice of the best one of them. In real practice, as a rule, such a situation does not occur. A new version of equipment or technology for the replacement of the existing one is proposed. The basic question here is whether the given innovation is to be or not to be, whether it is to be developed, and if it is developed, whether it is to be introduced. It is necessary to ascertain what criterion is more objective for the comparison and the making of a decision.

The sought indicator should ensure:

1) the efficiency of management, that is, the obtaining of the criterional value in a time which makes it possible to intervene in good time in the progress of the process;

2) a characterization of the controlled object as a whole, and not a separate part of it;

3) the direct expression of the result of the effect (the attainable progress) in the form of a function of the manipulated variables, and not a function of a function;

4) independence from incidental, extraneous factors;

5) the ability to be planned and controllability.

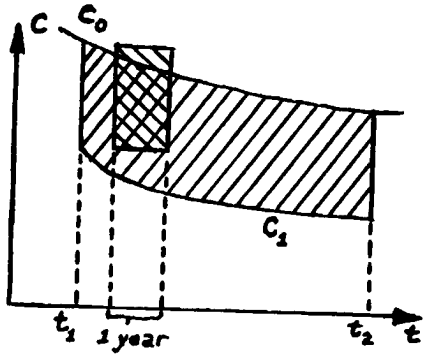
Let us initially see how the economic impact satisfies these requirements. First of all let us note that it is a one-time, single value. Scientific and technical progress is discrete and is formed from a large number of individual innovations, each of which makes its contribution to the overall change (improvement) of production. No matter how drawn out and branched the group of participants in the development of an innovation is, its impact is unified. Accordingly, no scientific research development or experimental design development in itself has an independent economic impact. It is achieved in case of production realization, while respect to a scientific research development it is possible to speak of its potential or (if introduction has occurred) real value for the equipment which was produced as a result of this development.

In the simplest interpretation the economic impact of a scientific and technical innovation is the difference of the adjusted expenditures between the version "being superseded" (the base version) and the version being introduced. This principle was recorded for the first time in [2] and since that time has not changed; the methods of calculation have been improved and differentiated. Frequently (especially for minor innovations which do not affect the fixed capital) instead of the difference of the adjusted expenditures the difference of the production costs of products or even individual components of it (what is called "the calculation according to changing elements of the expenditures") is taken into account.

Let us trace a single act of the formation of the economic impact for the simplest case, when a technological innovation, which leads to the decrease of production costs in case of the output of a former (invariable) product, is introduced at a separate enterprise. The new technology is used for several years, until a more advanced (the latest) technology takes its place. It is obvious that if there were no new technology, the production cost of the given product would remain until the appearance of the latest unchanged technology. The amount of the decrease of production costs during the entire period of operation of the new technology from the moment of introduction to the moment of "supersession" is also the total economic impact. In real life, of course, introduction does not occur instantaneously and might at first lead not to a decrease, but to an increase of production expenditures (or to additional

expenditures during the period of assimilation), but this does not change the overall scheme.

Consequently, it is possible to determine the total impact of new technology only after the end of its existence, that is, its supersession by the latest technology. The real value of the indicator is determined post factum. Thus, the first of the listed requirements is not observed--the value of the indicator is established too late for the purposes of efficient management (after the end of the controlled process).



In order to shorten the time of the identification of the criterion, they replace the total economic impact by the annual economic impact. By calculating it in accordance with the accepted methods for the first or second year of the existence of an innovation, we determine the conditional value which should serve as if as a "representative" of the total impact. In the figure t_1 is the moment of the introduction of new technology, t_2 is the moment of its "supersession." Let us assume that introduction did not require capital expenditures, and it is possible to use the difference of the current production costs, as well as that the costs as a result of introduction immediately decrease from C_0 (the production cost in case of the old technology) to C_1.

It is obvious that the technology "being superseded" in case of its retention would not remain absolutely unchanged, but would somehow improve; it is legitimate to regard C_0 as a diminishing function of time. Especially as the new technology at the moment of introduction has reserves which will gradually be used, which will entail a decrease of the production cost C_1 during the period in question. The total impact is expressed by the cross-hatched part of the graph. The rectangle with double hatching in the figure is the annual impact. Its representativeness with respect to the total impact is very conditional. The production cost in case of the old technology at the moment of its supersession or during an earlier period (depending on what data we use)[2] serves as the upper boundary. The production cost with respect to the new technology is also used with a certain degree of conditionality, for this is a not yet stabilized value.

Such is the situation in case of a single act of the introduction of an innovation. If it is unique (applicable to only one production unit), the creation of the impact is confined to this. If the innovation can "be circulated," that is, be used, for example, at several enterprises, summation over the entire range of application is also required. But since this process is drawn out in time, at the moment of the calculation uncertainty also exists with respect to the indicated range.

Consequently, the examined annual impact is a conditional value, and conditional in two ways: with respect both to the time of the use of the innovation and to the extent of its application. The second requirement is violated--we obtain a characterization which encompasses not the entire process, but its fragment. The annual impact can serve as an approximate characterization of the total impact, but the degree of its reliability depends on how accurate the ideas about the future change of the difference of the production costs (or the adjusted expenditures) and the amounts of use are. Let us note, moreover, that the uncertainty of the values in question for a scientific and technical development is greater than in case of the direct introduction of new equipment (technology).

The situation is more complicated in case of a change of the product, when the result appears not in the introducing, but in the subsequent units (or in one of them): items with better consumer properties yield an impact in case of their use.

Let us assume that new technologies of the refining of some metal have been developed and are being introduced. In one case the innovation makes it possible to produce it with the same consumer properties as before, but with fewer expenditures, in the other it is possible to obtain purer metal, which gives new qualities to items made from it and a specific impact in case of their use. We will distinguish in conformity with this the impacts of the first and second type, and not a decrease, but an increase of expenditures in the introducing unit is characteristic of the latter, since there exists a common empirical dependence which connects the increase of the technical parameters in case of the improvement of items with the leading increase of the cost of the latter [3].

In [2] the direct impact for the producer and the impact for the user as a result of the introduction of improved equipment were differentiated, and it was also prescribed to add up in case of the improvement of a product both impacts on the basis of their presumed similarity. In reality, as was pointed out, they have only a common form, the economic content differs substantially. If there are instances when a decrease of costs is achieved simultaneously by both the producer and the user, this is an exception which underscores the general rule.

In works on the theory of economic efficiency the indicated differences are not taken into account, while the impact is regarded as a whole as a homogeneous category. It is usually customary to differentiate between the absolute and comparative impact of capital investments. The former "is the increment of the new product (national income), which was obtained owing to the equipment of living labor with additional or improved means of labor" [4,

p 115], while the latter is an indicator of the profitability of one method of carrying out production actions with respect to another (given the achievement of identical results), that is, "reflects the relative saving of expenditures, which is obtained from each ruble of investments in case of the implementation of the best version of new equipment as compared with the equipment which was taken as the base" [5, p 8]. When determining the economic efficiency of scientific and technical progress it is always necessary to deal with the comparative efficiency, since the changes of production are to be evaluated. But they can in principle differ from each other, which for the present is taken inadequately into account by theory.

The impact of the first kind (that is, the direct impact, which appears at the introducing enterprise from the change of technology, which makes it possible to decrease the costs) is defined directly as a value which has a specific reference point (the former production cost or adjusted expenditures). The impact of the second kind (that is, the saving from the use of a product which has been updated or improved by its producer) depends not only and not so much on the introducing enterprise's own efforts and the expenditures connected with them, but also on what the costs in the preceding unit are.

Thus, the third requirement is also not satisfied for the indicator of the impact--only in a minor portion of the cases does it directly characterize the attainable progress, but for the most part it acts as "a function of a function" and is connected only indirectly with the direct results of introduction.

This indirect nature is a factor of profound economic importance. The current division and cooperation of labor are giving rise to multilink production chains, in which each preceding link not only transfers to the next one its own product as a semifinished product (until the process concludes with the output of the final product), but at the same time also transmits innovations. The development of a new polymer, having been introduced at a plastics plant, leads to the output of a more advanced material, from which, in turn, new plastic parts are produced at this enterprise; the introduction of the latter at a machine tool building plant provides an economic impact, making it possible to supersede parts made from nonferrous metal. If owing to parts made from plastic improved consumer characteristics appeared in machine tools, the metalworking enterprise, which uses these machine tools and which also acts in this case as the final link of the introduction of the innovation, obtains the impact.

The differentiation of the profit from scientific and technical measures among the links at times is connected with the categories of the cost accounting and national economic impact: "...in the end the content of both the national economic and the cost accounting impact is the saving of expenditures, which has been obtained by means of it. In the former case this saving is calculated as the aggregate saving and its influence on the increase of the national income (the net output) is determined, while in the latter the saving is taken separately for the producers and users, moreover, the influence of this saving on the cost accounting indicators--the profit--is determined" [6, pp 254-255]. In reality the economic relations connected with the spread of innovations do not reduce to whether the impact is to be calculated as the

aggregate impact or for individual links. The combination of the latter is very diverse; the delimitation of the categories of the impact in question is a simplified reflection of the actually existing multilink nature. The impact of the second kind is formed at the end of the production chains; the number of versions arising here is determined by the type of the result to which the introduced version gave rise. The appearance of a new (or improved) product, as has already been noted, is the starting point, but in the next link (that is, for the user) the immediate result can be:

1) the output of new tools of production (a material improved by the producer made it possible to update the design of a machine at the user plant);

2) the production of new objects of labor (as in the above-cited example with plastics);

3) the improvement or updating of the technological process (a more advanced tool of labor, which has been updated by the producer, decreases the cost of the production process for the user);

4) the meeting of nonproduction needs.

The chain breaks only in the last two cases. Assume that the development and production assimilation of a new chemical compound made it possible to develop a sensor, by means of which it was possible to design an automatic control system, having replaced manual control with it. Each of these associated sequential innovations came about in its own sector, the impact was realized in the last link, where the change was technological. If the sensor began to be put on sale for use, for example, in passenger cars, the link which produces the sensors becomes the final one; the economic impact in this case according to [7] is defined as the profit from the sale of the total finished product.

In the literature the complexity of the formation of the economic impacts was examined primarily in connection with the cooperation of parallel coperforming developers. The multiplicity of participants in the development of a single innovation (especially in cases of the implementation of comprehensive programs) creates the problems of proportionate participation, the delimitation of creative and executive contributions and so on. However, as we see, the cooperation of successive production units, which use innovations, gives rise to even more problems: only the final unit, as a rule, has an economic impact, while the preceding ones incur additional expenditures; when identifying the impact it is necessary to trace the chain of production changes to the place at which the improvement of the technology is occurring or the output of a product for nonproduction consumption is being carried out (the prevailing methods do not take this important feature into account); the expression "the economic impact of new equipment," strictly speaking, is incorrect--new technology or a process, which is carried out by means of this equipment, has it; the cooperation of works gives rise to the cooperation of production changes.

The last circumstance is responsible for another obstacle in the way of the use of the economic impact as a tool for the management of scientific and

technical progress. For example, the design of an updated machine tool in addition to plastic parts can envisage a number of other innovations, which have been introduced both by the inventor's own idea and by the achievements of metallurgy, technical cybernetics and so on. Against this general background it is a difficult task (apparently, in most cases also an irresolvable one) to distinguish the impact from a separate innovation. The fourth requirement is violated--the indicator is not defined in a "pure" form which is free of extraneous factors.

It should be taken into account that the economic impact characterizes not the new equipment itself, but the transition to it from the equipment being replaced: its value equally depends on what is introduced and what is superseded.

Let us now consider how the indicator of the technical and economic level (TEU) looks as a measurer of scientific and technical progress, to what extent it satisfies the requirements presented above. First of all, as was pointed out above, scientific and technical progress is formed from the improvement of production and the product. Therefore the measurer, which is called upon to directly reflect it, should take into account this duality, combining both technical and economic indicators. Everything that pertains to the improvement of production itself (its equipment, technology and organization) in the end leads to the decrease of the costs, the level of which will also be an economic component of the technical and economic level. The improvement of a product finds direct expression in the increase of its technical level (or, more broadly, its consumer characteristics).

In contrast to the economic impact there is no officially approved method for determining the technical and economic level (for the present verbal definitions like "conforms to the world level," "conforms to the domestic level" are used). In our opinion, such a method should take into account the following circumstances:

--the degree of technical perfection is a universal common value, therefore the world technical and economic level should be the reference point;

--whereas for calculations of the economic impact they use documented numerical data, for the evaluation of the degree of conformity to the world level there is no such information;

--it is possible to establish quantitatively the values of the world technical and economic level only by means of an expert evaluation, which is then liable to official approval.

Of course, as in the case of the economic impact, one should distinguish the absolute and relative level, but for the purposes of the management of scientific and technical progress, obviously, it is necessary to know only the latter of these values. Thus, a standard is needed.

It is possible to suggest the following procedure of its determination. Data on the technical parameters of foreign and domestic items, which correspond to its specialization, are gathered by the forces of the information organs which

exist in every sector. Then they are generalized and undergo a critical analysis, since, for example, for advertising purposes the parameters of foreign items might not conform to the economically advisable level. The list of considered parameters and their values, which are recognized as best, are approved in accordance with the officially established procedure for the next 2-3 years (or for some other period) as the standard ones. In essence this is nothing but the "leading standard," with which each actual characteristic of the product being produced is compared separately. The comparison will give relative dimensionless values, the product of which will be the actual technical level.

A similar operation should also be performed with the production costs, although this is more difficult from an informational point of view, since firms, which readily advertise their technical achievements, do not strive to generalize the data on their expenses (moreover, the problem of their comparability for different countries arises). Nevertheless, it is impossible not to take this aspect of progress into account: we need a high quality of items, but not at any cost. A common index--a single numerical characterization of the technical and economic level of the given product--is calculated after obtaining the partial evaluations. It makes it possible to judge whether the world level has been achieved for the latter or what the lag behind it is.

The technical and economic level is an indicator which is determinable at all the stages of scientific and technical progress. The technical component is evaluated with a sufficient degree of reliability from the results of laboratory or pilot industrial tests. With the changeover to introduction the first items give accurate indicators of the technical and economic level in contrast to the economic impact, the total amount of which can be established only after the end of the production of the given type of product. In all cases the technical and economic level is a direct characterization of what is being achieved as a result of scientific and technical progress at a given specific works. It makes it possible to plan changes of the latter (the improvement of the parameters of the product, the decrease of its cost) and to discover immediately the fulfillment or nonfulfillment of these assignments. Timely intervention in the process of introduction is thereby ensured. The first demand on the indicator, which is used for management, is met.

The situation is similar also with the second requirement. Owing to nondimensionality the technical and economic level lends itself to decomposition when shifting from the top levels to management to the lower levels and, on the contrary, it is possible to generalize it, if it is necessary to shift from partial evaluations (of a separate product) to consolidated evaluations (which apply to a sector). In other words, by means of this indicator it is possible to characterize a single item, series production, the production section, the enterprise and the sector.

By its content and means of measurement the technical and economic level serves as an immediate response to control actions and therefore makes it possible to judge their rationality, that is, is a direct function of the actions from which the management of scientific and technical progress is formed. Consequently, the indicator satisfies the third requirement, in

contrast to the economic impact, which is formed at the end of a multilink chain and experiences the influence of various extraneous factors.

Moving to the fourth requirement, let us note that the economic impact of a technical innovation (and in general of any change of production) is a relative value in the sense that it gives a characterization of the transition from the equipment being replaced to the new equipment, from one state to another. The level is an absolute value, it reflects the achieved state itself regardless of what was replaced by the innovation. This comparison alone testifies that there is no direct connection between the impact and the level. A high technical level of a developed machine tool leads to economic impacts of different value subject to whether it will supersede a comparatively modern or a hopelessly obsolete tool of labor.[3]

In both cases we take the reading from some base, but in case of the calculation of the impact it completely determines the value of the indicator. It is possible to have a very high value of it in case of the transition from very poor to simply poor equipment, from simply poor to mediocre equipment. Such an indicator does not meet the fourth requirement, since its value is only partially connected with the innovation being introduced and cannot serve as a tool of the campaign for scientific and technical progress.[4] The technical and economic level is also reckoned from a base--the standard level. But the nature of the connection with the reference point is different here--errors in the determination of the base value, but not it itself, can influence the value of the indicator.

And, finally, a decisive circumstance. In order to manage scientific and technical progress, which is formed from specific innovations at specific enterprises, it should be given, and then checked in the indicators, which the given enterprise completely "controls" and for which it is possible to make it answer. The enterprise, by changing its technology and the equipment being used and improving the product, is completely responsible both for the production costs and for the consumer properties of items, but not for the economic impact, which is not dependent on it and is obtained at the end of the chain of cooperated enterprises, at a plant of a completely different type or a different ministry (just as it is impossible to include in the plan assignment for a plastics plant the output of metal-cutting machine tools with plastic parts). In the last case the observance of the fifth requirement is ruled out.

Only the impact of the first type can be a plan indicator, but it appears, as was already pointed out, only in a limited number of cases. The impact of the second type, acting as a remote consequence of the fundamental changes of production at the introducing enterprise, is not liable to direct regulation on the part of the latter, which in no way makes it possible to use this indicator either for the assurance of administrative legal responsibility or for the direct stimulation of production.

Thus, the dilemma reduces to a choice: the level or the impact. The management of scientific and technical progress, which is oriented toward the level indicator, will strive for the implementation of major pioneering innovations, since only they lead to the achievement of the world level. An

orientation only toward the economic impact implies a policy of the evolutionary improvement of existing equipment and technology, since there is incorporated in the very concept of the comparative impact its comparison with the prototype for the same purpose, which is being superseded (the requirement of the identity of the result). All this entails the danger of a technical lag. The overall result is that the use of the technical and economic level as the basic indicator seems preferable for the management of scientific and technical progress and for the uniting of science with production. It is necessary to make it official and to direct efforts at the elaboration of the general principles of its determination, methods of calculation in specific situations and the rules of planning and reporting.

But this by no means implies that the economic impact as an indicator of progress should be rejected. A knowledge of the attainable state (level) and transition is necessary for the purposes of management. A synthetic measurer, which encompasses both the impact and the level, which reflects both the degree of progress from the equipment of yesterday (the economic impact) and the approximation of the world standard, that is, the equipment of tomorrow, is needed in order to obtain evaluations at earlier stages, when decisions affect the fate of proposed ideas and inventions, the choice of themes of scientific research work and so forth. We will call such an indicator the importance and will include within it in addition to the economic impact and the technical and economic level additional characteristics, such as the universality of the use of the proposed innovation, the ability to be patented and others.

At the stage of the production realization of innovations and the obtaining of a real contribution in the form of the increase of labor productivity, the saving on expenditures and the updating of products the technical and economic level is brought to the forefront as a direct measure of the attainable progress. Finally, an evaluation in monetary form, which allows comparison with the expenditures and as which the economic impact acts, is required at the later stages when summarizing the activity and giving rewards.

At the 26th CPSU Congress the task was formulated with the maximum clarity: "Conformity to the best world and domestic models--we cannot and should not agree to anything less" ["Materialy XXVI syezda KPSS" [Materials of the 26th CPSU Congress], Moscow, Politizdat, 1981, p 43]. The fulfillment of this program directive requires a reliable measurer of scientific and technical progress.

FOOTNOTES

1. In general it is more correct to use the concept "consumer level," because both the parameters of products for production purposes (equipment) and the properties of items for nonproduction consumption can be improved. The technical level is a special case of the consumer level.

2. Since the information for calculations should be documented, we were forced to use, as a rule, the reporting data of past years.

3. Due to the lack of a means of transition it is practically impossible to use the instruction contained in the methods that it is necessary to take the best equipment at the given moment as the basis for comparison. This instruction itself is recognition of the primacy of the technical and economic level ("best" also means "having the highest level"), although nothing is said about how to determine it.

4. The opinions of experienced workers attest that the orientation toward the economic impact at times leads to the preference of minor improvements as compared with revolutionizing innovations. Thus, in [8] it was noted: "Is the role of the economic impact not exaggerated when evaluating the labor of innovators?" And immediately an example is cited: "...the author of some unusual washer, which is circulated in billions of pieces, in case of a kopeck return from each one can obtain the maximum reward," while the inventor of new tools of labor remains in practice without reward.

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GENERAL

ECONOMIC IMPACT, TECHNICAL, ECONOMIC LEVEL OF INNOVATIONS

Moscow EKONOMIKA I MATEMATICHESKIYE METODY in Russian No 2, Mar-Apr 85 (manuscript received 10 Nov 84) pp 315-323

[Article by V. L. Makarov (Moscow): "On the Indicators of Scientific and Technical Progress"]

[Text] The present stage of the development of socialist society is characterized by the increase of the role of economic methods in the management of the national economy. General Secretary of the CPSU Central Committee Comrade K. U. Chernenko indicated: "...it is necessary to give scope to the introduction everywhere of cost accounting principles. Everything that hinders this should be eliminated" [K. U. Chernenko, "Narod i partiya yediny" [The People and the Party Are United], Moscow, Politizdat, 1984, p 12]. This principle fully applies to the management of scientific and technical progress.

In the economic domain for the immediate historical period the country is faced with two main strategic goals: the assurance for the 12th Five-Year Plan and for the subsequent period of the stable, dynamic growth of the economy; the achievement of a technical and economic level, which conforms to the best models in the world from the point of view of efficiency and quality, of the most important types of products and technology and, in the future, also of the national economy as a whole.

These goals should be achieved by means of, on the one hand, the more efficient use of the available production potential and, on the other, the rapid and continuous updating of all the sectors of the national economy on the basis of the current achievements of science and technology [Ibid., pp 18-19].

The former factor can be realized by the implementation of a set of organizational and educational measures which do not require significant capital investments and material expenditures. Here such measures as the tightening up of discipline and the improvement of material and moral stimulation yield a quick return, others (for example, the rearrangement of the economic mechanism and the organizational structure of the management of the national economy) are of a long-term nature and affect the improvement of matters gradually. The latter factor--retooling on the basis of fundamentally

new equipment and technology--is by its nature long-term and to a significant extent is governed by scientific and technical progress.

At present it is being recognized more and more often that the pace of scientific and technical progress can be sped up mainly by the creation of a favorable economic environment for the extensive use in practice of the latest scientific and technical achievements. It is necessary for every unit of our economy to be oriented toward the realization of the formulated strategic goals. For this, first of all, it is necessary to improve the indicators of the evaluation of the functioning of all units of the national economy.

The goals and evaluation indicators, in our opinion, are divided into those which are of a quantitative and qualitative nature, although, of course, such a division to a certain extent is arbitrary.

Thus, the goal of the assurance of a high stable growth rate can be considered quantitative, while the achievement of a high technical and economic level can be considered qualitative. The economic impact in the national economy (NEE), which is close to the amount, which is cost accounting in content, of the accounting (net) profit, in this case is the "quantitative" indicator which orients all the units of the economy toward a high stable growth rate. The technical and economic level (TEU) will play the role of the "qualitative" indicator which disposes one to the utmost implementation of the achievements of scientific and technical progress. In our opinion, precisely these indicators correspond to the stage of the intensive development of the economy and direct attention to the quickest retooling of production on the basis of the introduction of scientific and technical achievements, by complementing each other.

1. The Main Indicators of the Evaluation of the Work of the Economic Organization

Balance, efficiency and quality--such are the current demands on the development of the national economy. The indicators of the evaluation of economic activity and its management should correspond to them. Moreover, those of them, in accordance with which the work of the enterprise, sector and so on is evaluated, should have a clear economic content and should be measured reliably. The search for such measurers is constantly being made both in economic, management and planning practice and in theoretical research. In some works three indicators are proposed as the main ones: 1) the percent of fulfillment of the plan on contractual deliveries; 2) the accounting (net) profit; 3) the technical and economic (technical) level of products, the enterprise and the sector. Each of them, of course, is only "the tip of the iceberg," beneath which an entire set of primary characteristics is concealed.

The percent of fulfillment of contractual obligations has already begun to have an influence on economic activity. Several hundred enterprises, which are under the conditions of the large-scale experiment which was begun on 1 January 1984 in conformity with [1], have appreciably reorganized their work. The enterprises of light industry of Belorussia and the food industry of the Ukraine completely (by practically 100 percent) fulfilled their

contractual obligations during the first half of 1984. In the experiment the indicator in question has been made decisive in case of the formation of the funds (particularly the economic stimulation funds) which are left at the disposal of the enterprise.

The indicator of the accounting profit--an internal indicator for enterprises--is not a directive planning indicator which is approved by superior organs. Its value, which is reflected in the financial and accounting returns, characterizes most reliably the economic efficiency of its economic and, in particular, production activity. The superior organs have the opportunity to control this indicator by means of standards of deductions from the balance sheet profit for the budget, payments for credit, for funds and so on, as well as by price regulation. These levers will effectively influence the work of the enterprise only if the standards are approved for a sufficiently long period and do not change subject to the results of current activity, while their revision is carried out only in case of a significant change of production conditions.

Finally, the technical and economic level takes in the entire range of consumer, qualitative and technical characteristics of products and technology. By its nature this is a directive planning indicator. Whereas the standard of the net profit, being incorporated in the mechanism of the stable proportionate distribution of revenues, provides a favorable economic environment for the introduction of innovations in production, the indicator of the technical and economic level is a lever of the centralized management of scientific and technical progress and the achievement of the main goals of scientific and technical development and its priority directions. In contrast to the first two it was used only as applied to specific works and items. Its extensive, universal use as a leading indicator is a new task in the area of the improvement of the mechanism of the management of the socialist economy.

A number of measures on the evaluation of the technical and economic level of products and technological processes in the sectors of industry are outlined in the decrees of the CPSU Central Committee and the USSR Council of Ministers "On Improving Planning and Strengthening the Influence of the Economic Mechanism on Increasing Production Efficiency and Work Quality" of 12 July 1979 and "On Measures on the Acceleration of Scientific and Technical Progress in the National Economy" of 18 August 1983, as well as in the decree of the USSR Council of Ministers "On Measures on Tightening up the Monitoring of the Technical Level and Quality of the Products Which Are Being Planned for Production at Enterprises Being Constructed, Expanded and Renovated" of 27 September 1979.

The last two of the decrees in question are, in our opinion, the key ones in the mechanism of the management of scientific and technical progress.

2. The Economic Impact in the National Economy

The economic impact in the national economy (NEE) of an economic measure is defined as the difference between the total result of the given measure and the total expenditures on its implementation, which are calculated in current or accounting (long-range) prices (see, for example, [2, 3]). The word

"total" here underscores the fact that it is a question of the economic evaluation of a measure in the full amount and for the entire period of implementation with sufficiently extensive consideration of the factors and side effects.

The problem is how to calculate reliably and objectively the economic impact in the national economy under the conditions of real practice.

The determination of the total expenditures of an economic measure is a relatively simpler operation than the calculation of its results. The methodology and methods of calculating the expenditures are constantly being improved, in particular, new components of them, which were previously not taken into account, are being encompassed. However, for the present there is no uniform standardized, clearly described method of their calculation.

The problem of calculating the economic result of an economic measure is even more difficult owing to the uncertainty, the existence of side effects, the need for a forecast of prices for a product, which has never yet been produced, and so forth. In the methods of comparing the expenditures and results there are also their own difficulties. As is known, starting in the late 1950's in our country methods of evaluating the economic efficiency of some types of economic measures or others began to be elaborated and used in practice. At present there are several hundred such methods [4], which, as a rule, are inadequately interconnected and at times contradict each other. Their status is not clearly defined, the degree of mandatoriness of their recommendations is low, the connection of the indicated recommendations with cost account indicators is not properly regulated.

The task is to make the calculations of the economic efficiency an effective lever in the making of decisions and a realistic "filter" which selects the truly best measures. The solution of this problem should proceed in two directions, which are mutually complementary.

The first direction is the assurance of the connection of the economic impact in the national economy with the cost accounting indicators of the work of enterprises and organizations, and first of all with the indicator of the accounting (net) profit. The examples when innovations, which are efficient from a national economic point of view, are not introduced due to the fact that their use worsens the indicators of the activity of an enterprise, are widely known. The difficulty of the problem lies, in particular, in the fact that the economic impact in the national economy and the cost accounting impact have different addresses. Whereas according to the former the expenditures and results clearly correspond to a specific innovation (new equipment, a technological process and so on) and the difficulty consists in attributing them to the economic organization, the latter has the opposite picture. The results of activity in conformity with the prevailing system of accounting are determined for the organization, and the singling out of the portion, which is directly connected with the given innovation, is a difficult task.

Individual studies on the problems of the technical and economic level are being conducted (see, for example, [5, 6]), but they are of an uncoordinated

and sporadic nature. It is necessary to intensify them to the maximum degree within the program of work on the development of a unified statewide system of the certification of products, which are being developed, are being accepted for production and are being put out.

It is generally accepted that the technical and economic level of any item, material and technology is measured by an entire set of physical and value indicators which are different in nature. Here, of course, for different products the sets of indicators differ substantially and it is impossible to compare them. To a certain degree such sets are comparable within similar groups of products, but there are very many of the groups themselves. Thus, in any case it is necessary to perform some operations or others on the initial set of characteristics of the technical and economic level.

There are two approaches to the determination of the integral technical and economic level in accordance with the primary indicators. The first is based on the comparison of the values of the technical and economic level of the object being studied and some ideal object, which embodies their potential values, which in principle are achievable for the materials, items and technologies in question at the given level of the development of science and technology. However, a production prototype with such characteristics far from always exists. In individual cases it may be sufficient for the required values to be obtained in experimental production or even under laboratory conditions. However, additional difficulty arises when there are different prototypes with experimental data, from which it is impossible to judge unequivocally which of them is preferable.

The actual technical and economic level of a product, technology and material is determined according to the same indicators as the potential technical and economic level. Their specific values are derived under the average typical conditions of the given works.

If the above-noted difficulties are overcome, by knowing the potential and actual initial characteristics it is possible to obtain an expression for the technical and economic level in the form of one dimensionless number.[1] The simplicity and intelligibility of such a method of determining the technical and economic level stems from the connection with the very concept of a level. For example, if the potentially achievable value of the consumption of gasoline is 5.4 l per 100 km of running for the given class of passenger car, a consumption of 10 l gives the value of the level with respect to this indicator of 0.54 (or 54 percent). In the electrical equipment industry this method of determining the technical and economic level has been used for a number of years now [5]. Convincing arguments in favor of the fact that for the dimensionless numbers, which were obtained in the indicated way and reflect the actual technical and economic level (as compared with the potential level), it is possible to take the average value for various items, technologies and materials, and as a result a sensible value, which characterizes the technical and economic level for the set of items which are produced by individual enterprises, will also be obtained, are cited in [7]. However, in a number of cases the natural difficulty of determining the weights for the primary indicators of the technical and economic level arises here.

The second approach to the calculation of the integral technical and economic level is based on the use of the concept of the use value of an item and the reduction of all the values reflecting it to one conditional indicator of the consumer impact or the useful work, by the assignment of which to the total expenditures on the production and use of an item the technical and economic level is also determined. Often the productivity of the corresponding type of equipment is taken as the effective impact. The concept of the aggregate effective impact is used for multipurpose items.

The second approach to the calculation of the technical and economic level in the scientific and practical respect has still been inadequately studied and does not have the universality which is characteristic of the first one. Apparently, it is advisable to use it only for several types of products.

The determination of the technical and economic level for the enterprise, the sector and especially the country as a whole is an even more difficult problem. One of the possible methods is "from below," by means of the averaging of the technical and economic level of the products produced by an enterprise and, perhaps, the technical and economic level of the technological processes which are being used in this case. However, here the so-called systems impacts are not taken into account. In particular, the technical and economic level of an item, especially a complex item, owing to their effect is not formed from the technical and economic level of its components, but are frequently determined almost entirely by the lowest of these indicators. Moreover, the technical and economic level of an item, as a rule, contains such characteristics which do not make sense for individual types of materials and technology. The noted circumstance is especially essential when determining the technical and economic level of the enterprise, the sector or a more complex formation. Therefore, the movement "from the top," in case of which along the technical and economic level of the items being produced and the technological processes being used special indicators of the technical and economic level of the corresponding unit of the economy are calculated, will be the correct approach here. The systems impact also appears in the fact that the values of several indicators, which reflect the technical and economic level of an item or technology, depend on the conditions of their use or on the organizational economic and technical environment in which they function. A robot as a part of an automatic line and in manual production performs different useful work.

The indicators of the technical level of sectors, which are being used at present when compiling the plan of the development of science and technology, in a number of cases are of a particular nature. There are not enough indicators, with respect to which it is possible to compare the technical and economic level of different sectors. The need to step up the work on determining the technical and economic level of enterprises and sectors follows directly from the above-indicated decrees of the Communist Party and the Soviet Government.

4. The Interaction Between the Economic Impact in the National Economy and the Technical and Economic Level

On a purely theoretical level a larger economic impact in the national economy implies at the same time a higher technical and economic level, and vice versa. Therefore, the technical and economic level in traditional mathematical models of the economy did not emerge as a special concept and as a special control parameter. The point is that in such models an item with a higher technical and economic level is a different product which also has a higher price. In an abstract mathematical system it is assumed that all the indicators of the technical and economic level are present in the description of the large number of technologies of the production of products, and their influence on the end results is reflected in the corresponding prices.

In practice pricing takes into account the technical and economic level by means of a certain system of markups for the output of products of the highest quality category, here there are instances when the prices are oriented toward the individual costs, which ensures an average level of the economic impact in the national economy for production with a backward technical and economic level. In the existing economic mechanism the indicators of the economic impact in the national economy and the technical and economic level frequently operate in different directions and at times are at variance with each other.

It is easier, as a rule, to achieve a greater value of the economic impact in the national economy in the process of activity which is characterized by a significant economic turnover, with volume expenditures of material and manpower resources and productive capital. Economic managers frequently strive to introduce such innovations which increase this total economic potential, for example, they prefer new construction to renovation. Here the overall amount of the profit, and not its share in the sales volume, is in the forefront. The "weight" of the manager under the formed conditions of management is determined by the scale of the job which he manages. But the scale, as a rule, is measured by the value of the economic turnover. Meanwhile, it is simpler at times to achieve a high technical and economic level with a comparatively small amount of economic activity. Frequently an innovation, which is fundamental and, thus, has a high technical and economic level, having been introduced in production, decreases the indicated volume. For example [8], the use when laying underground main gas and petroleum pipelines of modern technology with the use of anchoring devices decreases the cost of the laying of 1 km of a pipeline 1,420 mm in diameter from 64,000 to 36,000 rubles, and the labor expenditures respectively from 56 to 53 man-days. However, the indicated technology decreases substantially the indicators of the fulfillment of the amount of contracting operations and the output (the latter is ten-seventeenths as great), which given the existing system are the basis for the evaluation of the results of the economic activity of construction organization.

This phenomenon occurs at all levels of the development and introduction of innovations (it is more profitable for the designer to develop something imposing and expensive).

When calculating the economic impact in the national economy, and especially its cost accounting expression--the accounting profit, it is difficult to take into account many indicators of the technical and economic level, including the diverse consumer properties of a product. Thus, it is extremely difficult, and at times impossible, to express in value form the strength, the roughness of machining, the precision of the size and similar technical characteristics. Consequently, the economic impact in the national economy and the technical and economic level each determine separately only one aspect of the phenomenon, reflect objectively different properties of innovations and therefore complement each other, although in theoretical models, as was already pointed out above, the technical and economic level can be taken into account in the economic impact in the national economy.

Another of the differences between the economic impact in the national economy and the technical and economic level consists in the fact that the reliability and importance of the former of these indicators as a parameter of management increases with the increase of the level of the hierarchy (from the individual product and production process to the enterprise, the sector, the region, the national economy as a whole), while the opposite picture exists for the technical and economic level--it becomes more comprehensible and natural with movement toward the lower levels. At the level of the shop, the section and the workplace the technical characteristics are easily measured and checked, here it is natural to place them at the basis of the plan of the improvement of production (and not only in the plans of the assimilation of new equipment); the worker, the foreman and the chief of the shop think in precisely these categories.

Several indicators of the technical and economic level directly indicate the directions of the increase of the scientific and technical potential, while the estimation of the economic impact here is made extremely difficult due to uncertainty in the future practical applications.

However, one of the most important differences of the economic impact in the national economy and the technical and economic level as evaluation indicators consists in the fact the the mechanisms, which correspond to them and induce one to seek and use innovations, just as these innovations themselves, can be different. The indicator of the accounting profit by its nature is intended for the work of an enterprise under the conditions of sufficient independence. Having become a fund-forming factor, it orients the enterprise toward the expansion of economic activity and the increase of the assets which are left at its disposal. The economic impact in the national economy stimulates the introduction in production of economically profitable scientific and technical innovations. These, first of all, are ones, which have already been tested at another place, do not require the breaking of established economic relations and so on.[2]

The technical and economic level should be the second plan indicator in priority for the enterprise (after the fulfillment of the plan of deliveries in accordance with contracts). This will make it possible to increase substantially the role of the plans of the introduction of new equipment and the renovation and retooling of works and will contribute to the real transformation of the plan on new equipment and the production plan into a

unified whole. The point is that the technical and economic level serves as the result of the final stage of the introduction chain (in series production), while its initial value is incorporated in its beginning (scientific and technical development). The examples of when the technical and economic level, while not formally being the leading plan indicator, in reality is taken as such by the management of an enterprise, are well known. It is possible to mention in this connection the Ivanovo Machine Tool Building Association.

It is possible to achieve a high technical and economic level only by the introduction of fundamental innovations in production. The proper assignment of its values should be regarded as the basic planning lever of the acceleration of scientific and technical progress at enterprises and in sectors. The reform of the system of the planning of production with an orientation toward the technical and economic level is a complex multidimensional problem, which it is necessary to solve in the immediate future.

5. The Unity of the Process of Developing, Introducing, Disseminating and Using Innovations

The idea of examining the entire life cycle of an innovation from its appearance to disappearance proved to be fruitful in the analysis of the problems of the management of scientific and technical progress [9]. It is customary to call the full life cycle of an innovation or set of innovations the innovation process. Since its basic stages (phases) are identical for all types of innovations, the opportunity appears to "build up" individual innovation processes according to various classification attributes. As a result innovation processes are formed for a specific sphere (the enterprise, the sector, the region, the section of science and technology and so forth) and, finally, for the entire national economy. This makes it possible to look in a new way at the management of scientific and technical progress.

Schematically the innovation process can be described as a table, the lines of which characterize its stages, while the columns describe the quantitative or other indicators which corresponding to them. Owing to such a description the operation of the "summation" of innovation processes becomes quite sensible and gives the key to the numerical and qualitative analysis of scientific and technical progress, particularly the following aspects of it:

--the degree of the mass character of the processes of the development and introduction of new equipment, the level of their need for manpower, material and financial resources;

--the interdependence of the stages in the "science-production" system, particularly the pilot experimental base, the changeover from the prototype to the series, the spread of innovations to other enterprises, sectors and spheres, removal from production;

--the identification of developments which have remained at the stages of scientific research work and experimental design development;

--the assurance of the unity of the planning, financing, as well as organization of development and the stages of the introduction in production of the finished innovation (including the technological preparation of production, the production of auxiliary equipment, the training of personnel, start-up and adjustment work).

Description of the Innovation Process

Stages	Characteristics: organizations responsible for fulfillment	content of stage	length of stage, years	number of employees	financial expenditures, rubles a year	economic impact, rubles	organizational forms	forms of financing
Origination of idea (incubation period)								
Scientific research work								
Experimental design development								
Pilot production								
Assimilation								
Production								
Spread to other spheres								
Removal from production								

The overall innovation cycle for the entire national economy includes current production as a stage and describes scientific research, introduction and production activity as a unified continuous process. For this process as a whole and for its components--local innovation processes--it is natural to regard the economic impact in the national economy and the technical and economic level as the final evaluation indicators. Here the bulk of the economic impact in the national economy is formed at the end of the process--in current production, especially series and mass production, while the indicator of the technical and economic level makes sense and can be changed at each stage of the innovation process. At the early stages an economic impact in the national economy does not form, it begins to appear in case of the use of prototypes and the output of an experimental series and achieves a maximum in case of mass dissemination in all spheres of use. Here the problem of allocating the economic impact in the national economy, which is obtained at the concluding stages, to all the preceding stages arises, which is important for the creation of the mechanism of economic interest in the full innovation cycle.

For the achievement of a high technical and economic level of the final product it is possible to proceed in different directions, the extreme ones of which are the following: to focus on the early stages of the process (that is, on the prototype) for the achievement of a high potential technical and economic level; to direct the main attention at the extensive introduction of finished innovations which have justified themselves in practice.

The implementation of the former of the indicated strategies has the result that the initial segment of the curve, which reflects the dependence of the technical and economic level on the stage of the process, becomes steeper, the gap between the potential and actual technical and economic level increases. The second strategy, on the contrary, is conducive to the smoothing of this curve and the convergence of the potential and actual technical and economic level. The best strategy should take an intermediate position with respect to the examined ones. A high profit (and a high economic impact in the national economy) might be obtained not in case of the maximum technical and economic level: its assurance requires increased expenditures.

The comparison of the dynamics of the potential and actual technical and economic level for different classes of innovation processes will make it possible to trace their dynamics and the influence on them of control actions and will help to obtain conclusions, on the basis of which it is easier to make correct decisions [10].

FOOTNOTES

1. For example, the actual technical and economic level, speaking in mathematical language, takes the form of the "norm" of the vector (the distance from the origin of the coordinates) of the values of the primary indicators in space, where the "norm" of the vector for the potential technical and economic level is equal to one.

2. Incidentally, in order to link the indicator of the net profit more closely with the problem of speeding up introduction activity at the enterprise, in the mechanism of the standardized distribution of the profit there should be envisaged a increase of the deductions to the funds of enterprises from that part of it, which is obtained by means of the use of innovations. This is first of all the profit from markups for the output of high quality products during the first and second year of their assimilation, as well as the profit obtained from the decrease of the expenditures of labor, materials and other components of the production cost in case of the introduction of new technological processes.

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